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THE AFRICAN SPECIES OF THE GENUS *OLIGOMYRMEX* MAYR (HYMENOPTERA, FORMICIDAE)

BY NEAL A. WEBER¹

This paper is based on new species taken on the Central African Expedition of the American Museum of Natural History and also includes all species hitherto known of this genus in Africa.² The types of all new species are in the American Museum of Natural History collections.

OLIGOMYRMEX MAYR

Oligomyrmex MAYR, 1867, Tijdschr. v. Ent., vol. 10, p. 110.

"♀ *Solenopsidi* simillima differt solummodo clypeo mitico posice obtusangulo, antennis 9-articulatis, alarum cellula discoidali subrhomboidea" (Mayr).

GENOTYPE: *Oligomyrmex concinnus* Mayr, 1867, Netherland Indies. (Female only and 4 mm. long.)

DISTRIBUTION: Tropical, Palearctic.

As Mayr originally indicated, the genus differs from *Solenopsis* primarily in having the anterior clypeal margin obtusely angulate rather than bidentate and in having the antennae nine-segmented. His original figure is merely that of the antenna of *concinnus*, clearly showing the nine-segmented condition and the two-segmented club.

Mayr, having only the female caste, could not know, however, that the genus differs also from *Solenopsis* in having the worker

¹ Swarthmore College, Swarthmore, Pennsylvania.

² The study has been facilitated by the Brayton Wilbur Research Fund of the American Museum of Natural History.

caste strongly dimorphic, the maxima being a large-headed soldier. These and other generic characters may be summarized as follows:

WORKER: Small to minute ants with dimorphic workers, the maxima being a large-headed soldier. Soldier with elongate head more or less rectangular, frequently with a median ocellus and minute eyes; mandibles stout, strongly curved, short, meso-epinotal suture distinct, epinotal teeth feeble, declivous surface more or less carinate at each side. Minima with head of average size and blind; head largely ovate with occipital margin feebly or not impressed, mandibles falcate with few teeth, no antennal scrobes; meso-epinotal impression distinct, feeble or no development of epinotal teeth; integument usually smooth and shining, yellow to ferruginous. Both castes have antennae nine-segmented with two-segmented club; clypeus bicarinate, obtusely angulate anteriorly; petiole and postpetiole rounded above, the petiole with a ventral tooth.

FEMALE: Small, with nine-segmented antennae and forewings with one closed cubital cell.

MALE: Antennae 13-segmented.

Ants of the genus *Oligomyrmex*, *sensu stricto*, were not taken by the American Museum Congo expedition. Wheeler notes (1922, p. 687) that the smallest ant then known was *O. bruni* Forel of Ceylon, the worker being 0.8–0.9 mm. and the soldier 1.5 mm. in total length.

The African species are:

- Oligomyrmex alluaudi* Santschi, 1914
- Oligomyrmex alluaudi* var. *cataractae* Santschi, 1919
- Oligomyrmex angolensis* Santschi, 1914
- Oligomyrmex angolensis* subsp. *congolensis* Forel, 1916
- Oligomyrmex arnoldi* Forel, 1913
- Oligomyrmex convexus*, new species
- Oligomyrmex donisthorpei*, new species
- Oligomyrmex erythraeus* Emery, 1915
- Oligomyrmex frontalis*, new species
- Oligomyrmex latro* Santschi, 1937
- Oligomyrmex santschii* Weber, 1943
- Oligomyrmex thoracicus*, new species

Oligomyrmex alluaudi Santschi

Oligomyrmex alluaudi SANTSCHI, 1914, in Alluaud and Jeannel, Voyage . . . en Afrique Orientale (1911–1912), Résultats scientifiques, Hymenoptera, 2, Formicidae, Paris, pp. 81–82, fig. 9, soldier, worker.

SOLDIER (AFTER SANTSCHI): Length, 1.5–1.6 mm. Head rectangular, a fifth to a fourth longer than broad, sides parallel, scarcely a little convex, the occipital border feebly concave, the angles rounded and without trace of teeth; clypeus sloping abruptly, with two blunt carinae, each terminating anteriorly in a small tooth between which the surface is emarginate; mandibles five-toothed; eyes very small, indistinct, formed by a single ocellus at the anterior fifth of the head; antennal scapes slightly surpass the middle of the head, funicular segments 2 to 6 shorter than broad. Pronotum globose, mesonotum indistinct, the promesonotal suture little or not distinct, epinotal incisure profound, epinotum raised a little anteriorly and with the basal surface a little broader than long, declivous surface shorter and concave, carinate (?) on each side, superior angle with small teeth somewhat longer than broad and slightly raised. Petiolar node a little longer than high, the summit transverse and rounded. Postpetiolar node a little broader than the petiole, a little broader than long.

Head reticulate-punctate except at the sides; genae striate, shining, and without punctation; occiput smooth posteriorly, under surface with large, confluent facets (reticulations?). Thorax, except on the promesonotum, and sides of pedicel finely reticulate-punctate; mandibles, middle of clypeus, pedicel above, and gaster smooth and shining.

Pilosity very fine, irregular, thin; pubescence very abundant. Color dull yellow, head brown, more or less yellowish, with the anterior border black.

WORKER (AFTER SANTSCHI): Length, 0.8–1.0 mm. Head a little longer than broad, broader posteriorly with the posterior angles very rounded, very excavated posteriorly; mandibles five-toothed; eyes minute, situated at the anterior two-fifths of the head; antennal scape slightly surpasses the posterior third of the head. Promesonotum a little longer than broad, the anterior and lateral borders convex; shoulders blunt, the promesonotal suture absent, the meso-epinotal suture impressed; epinotum as in the soldier, the spines somewhat longer than a third the interval at their base. Anterior border of petiole a little concave; nodes of the same (soldier?) breadth.

Matte, with a greasy reflection; head and thorax reticulate-punctate, mandibles smooth, pedicel reticulate, smooth on the nodes. Pilosity as in soldier.

Entirely dull yellow.

TYPE LOCALITIES: Shimoni (coastal, near Tanganyika border) and Kijabe (2100 meters altitude), Kenya.

***Oligomyrmex alluaudi* var. *cataractae* Santschi**

Oligomyrmex Alluaudi v. *Cataractae* SANTSCHI, 1919, Bull. Soc. Vaudoise Sci. Nat., vol. 52, p. 337.

SOLDIER (AFTER SANTSCHI): Differing from the type from Kilimandjaro by having the head slightly more narrowed, the clypeus a little shorter, and the postpetiole higher and thinner at the summit.

WORKER (AFTER SANTSCHI): Pronotum anteriorly smooth and shining (very sculptured in the type), the head narrower anteriorly, the first segment of the club more elongated. The mandibles have four teeth (the remainder as in the type).

TYPE LOCALITY: Victoria Falls, Rhodesia.

***Oligomyrmex angolensis* Santschi**

Oligomyrmex angolensis SANTSCHI, 1914, Bol. Lab. Zool. Gen. Agr. Portici, vol. 8, pp. 358-360, fig. 21, worker, soldier. WHEELER, 1922, Bull. Amer. Mus. Nat. Hist., vol. 45, p. 881.

SOLDIER (AFTER SANTSCHI): Length, 0.9-1 mm. Head rectangular, a fourth longer than broad, with sides a little convex and occipital margin slightly emarginate; eyes of one facet, a little in front of the middle of the sides; clypeus bicarinate, emarginate in the middle of the anterior border, convex; scape slightly surpassing the middle of the head, antennal segments 3 to 7 slightly broader than long, the terminal segment as long as the six preceding when taken together; mandibles four-toothed. Promesonotum globose, a little longer than broad, with the promesonotal suture little distinct; metanotal suture very impressed; basal face (of epinotum) marginate, concave and enlarged behind, slightly longer than broad, terminating in two teeth as long as a fourth their interval, broad at their base; declivous face strongly marginate, concave. Petiole a little lower than long, the node rounded at the summit, almost twice as broad as long. Postpetiolar summit slightly broader than the petiole but only a fourth shorter than broad. Gaster short, emarginate at each side of the pedicel. Very near to *Oligomyrmex alluaudi* and *jeanneli*, but

the first has a shorter head and the second has the sculpture more smooth.

Mandibles, middle of the clypeus, occiput, meso-epinotum, summit of the nodes, and gaster smooth and shining; head and remainder of the thorax matte and punctate; head also densely and very finely striate longitudinally with the base of the striations more shining and less punctate in front of the cheeks and clypeus than behind; striations at the sides of the head more or less anastomosing. Pilosity of a few long hairs on the body and a pubescence distributed chiefly on the appendages and the head.

Reddish yellow, head more reddish, gaster brownish yellow, legs and antennae yellow.

WORKER (AFTER SANTSCHI): Length, 0.8 mm. Head a little longer than broad, longer than in *alluaudi* and less enlarged behind; the scape nearly attains the posterior fourth of the head; mandibles of four teeth. Thorax broad in front and more marginate than in *alluaudi*; basal face of the epinotum clearly broader than long, with the teeth moderate, somewhat broader at the base than long. Petiole a little longer than high and a little broader at the summit than in *alluaudi*; postpetiole rounded, narrower.

Head, epinotum, and sides of the petiole matte, densely and finely reticulate-punctate, the remainder smooth and shining.

Reddish yellow.

TYPE LOCALITY: Quifangondo, Angola.

***Oligomyrmex angolensis* subsp. *congolensis* Forel**

Oligomyrmex angolensis r. *congolensis*, n. st. FOREL, 1916, Rev. Suisse Zool., vol. 24, p. 417.

SOLDIER (AFTER FOREL): Length, 1.4–1.5 mm. A little larger than the type, similar form of the head, but the latter has a very small carina on each side at the occiput. Clypeus strongly emarginate at the middle of the anterior border but without lateral carinae sketched and described by Santschi in the type. The extremity of the scape scarcely surpasses the middle of the head. Thorax scarcely as impressed. Epinotal teeth shorter than in those of the type, small and triangular. Head subopaque and densely striate anteriorly; rest of body shining and little sculptured. Dull, dirty yellow, head yellowish brown, antennae and legs yellow.

WORKER (AFTER FOREL): Length, 0.9 mm. Antennal scape attains the posterior fourth of the head; meso-epinotal suture a little deeper and epinotal teeth stronger than in the soldier. Petiole thicker and more rounded above than in the soldier, where its node appears higher and more compressed than in the type. Head matte, a little more reticulate and less striate than in the soldier. Uniformly yellow with a touch of russet except for yellow legs.

TYPE LOCALITY: Congo (Kohl).

***Oligomyrmex arnoldi* Forel**

Oligomyrmex arnoldi FOREL, 1913, Ann. Soc. Ent. Belgique, vol. 57, pp. 123-124, worker.

WORKER (AFTER FOREL): Length, 1.9 mm. Head impressed, somewhat broader than long, occipital margin almost straight, sides a little convex; antennae nine-segmented, scapes short, not nearly attaining the occipital border; three mandibular teeth; meso-epinotal suture distinct; petiole distinctly broader than long; postpetiole one and one-half times broader than long and similarly broader than the petiole.

TYPE LOCALITY: Rhodesia.

***Oligomyrmex convexus*, new species**

A species that is characterized in the soldier caste by the unusual convexity of the front of the head, the biconvexity of the occiput, and the presence of a pair of teeth; the head is reticulate-punctate.

SOLDIER: Extended length, about 1.5 mm.; of thorax, including neck, 0.46 mm. Head in front view, including mandibles, 0.50 mm. broad by 0.67 mm. long; occipital margin medially emarginate with a tooth on either side and with broadly rounded corners, sides convex, anterior clypeal margin produced as a lobe emarginate medially; eyes minute, situated at a level with the distal half of the scapes; median ocellus distinct, closer to the occipital teeth than the teeth are to one another; frontal lobes small and feebly convex; mandibles short, stout, triangular, highly convex, and with about five teeth; antennae nine-segmented, scapes 0.25 mm. long, clavate, bowed, two-segmented funicular club less than one and one-half times the length of the preceding funicular teeth taken together. Thorax from above with globose

pronotum 0.25 mm. broad which is over twice as broad as the basal surface of the epinotum; in side view with pronotum highly convex, the meso-epinotal suture distinct and the basal surface of the epinotum forming an obtuse angle with the declivous surface, the juncture being marked by obtuse teeth. Petiole in side view pedunculate, with node rounded above and rising at an angle. Postpetiole much lower than the petiole and, from above, of breadth similar to the petiolar node. Gaster elliptical and broadly excised anteriorly for the reception of the postpetiole, the corners rounded. Legs small and slender.

Shining; head reticulate-punctate, with reticulations becoming longitudinal striae near the frontal carinae; pronotum largely smooth above, sides of thorax and pedicel and entire epinotum punctate; gaster smooth. Pilosity of short, sparse, fine, upright hairs and a few longer, scattered hairs.

Yellowish brown with legs and antennae of similar color.

COTYPES: Soldiers and workers of one collection (no. 2080) taken February 17, 1948, at Busnia, Uganda, near the Kenya border.

Oligomyrmex donisthorpei, new species

A species characterized by the rectangular head of the soldier, which is slightly broader anteriorly, and by the absence of the median ocellus.

SOLDIER: Extended length, about 1.4 mm., of thorax, 0.45–0.49 mm. Head in front view rectangular, including mandibles, 0.40–0.45 mm. broad by 0.60 mm. long; occipital margin broadly excised medially and slightly carinate, corners rounded right angles, sides subparallel, being slightly broader anteriorly; anterior clypeal margin sinuate with two blunt angles formed by the frontal carinae, the space between concave and the carinae terminating at about the level of the antennal insertions; eyes minute at a level just posterior to the distal end of the scape when the latter is directed in that direction; no median ocellus; frontal lobes feebly developed, convex, not raised, diverging posteriorly; mandibles short, stout, triangular, highly convex, and with five teeth; antennae nine-segmented, scapes about 0.23 mm. long, clavate, slightly bowed, two-segmented club nearly twice as long as the remainder of the funicular segments taken together. Thorax from above with a short, convex, raised "neck," the remainder of the pronotum subcircular and fully twice as

broad as the epinotum; thorax in side view with evenly convex pronotum, slight meso-epinotal suture and plane basal surface of the epinotum which forms an obtuse angle with the declivous surface; epinotal declivity marginate on the sides and concave; no distinct epinotal teeth. Petiole in side view somewhat triangular, with node convex above and ventral surface slightly convex, posterior surface of node descending steeply. Postpetiole from above fully one-third broader than petiole, transversely elliptical; in side view lower than petiole, with convex dorsal surface and feebly convex ventral surface. Gaster in contracted state shorter than thorax and obtusely angulate at the anterolateral angles. Legs moderately short and slender.

Shining; head finely striate punctate, striae longitudinal and most distinct anteriorly, frontal area smooth; pronotum largely smooth, mesonotum and epinotum deeply punctate; pedicel, except nodes dorsally, punctate; gaster smooth. Pilosity of sparse, short, fine, recumbent hairs and a few longer and upright hairs especially at the clypeus, pronotum anteriorly, and gaster apically.

Yellowish brown, legs and antennal clubs brownish yellow.

WORKER: Extended length, 1.1 mm., of thorax, 0.26 mm. Head in front view, excluding mandibles, nearly one-fifth longer than broad, occipital margin faintly concave, corners broadly rounded, sides feebly convex and subparallel, anterior clypeal margin produced as a sinuate lobe over the base of the mandibles, paired clypeal carinae forming the most anterior convexities of the clypeus but not dentate; eyes minute, situated in front of the middle of the sides and well forward of the distal ends of the scapes; frontal lobes feebly developed and convex, not concealing the antennal insertions when viewed from in front; mandibles triangular, with an acute apical and about four much smaller teeth; antennae nine-segmented, scapes slender, failing to reach the occipital angles by more than half their lengths, two-segmented funicular club distinctly longer than the preceding funicular segments taken together. Thorax from above piriform; pronotum, excluding neck, transversely convex and more than one and one-half times broader than epinotum; in side view feebly and evenly convex above, the meso-epinotal suture barely indicated, basal surface of epinotum convex and terminating posteriorly in a pair of small, triangular teeth. Petiole in side view a triangle with node rounded above. Postpetiole much lower than petiole and rounded

dorsally but from above transversely elliptical and nearly two-thirds broader than the petiole. Gaster small and ovate. Legs of moderate proportions and length.

Sublucid; head, epinotum, pedicel, and meso-epinotal region with fine and dense piligerous punctations, pronotum and gaster nearly smooth. Pilosity of numerous short, recumbent hairs on the head, with the body generally with sparser pilosity; a few longer and more upright hairs chiefly on the clypeal region, the thorax anteriorly at the apex of the gaster.

Yellowish brown with antennae and legs paler.

COTYPES: Soldiers and workers (no. 2188) taken March 6, 1948, at Djema, Haut Mbomu, Ubangi-Shari, French Equatorial Africa. Dedicated to my esteemed colleague, Mr. Donisthorpe.

***Oligomyrmex erythraeus* Emery**

Oligomyrmex erythraeus EMERY, 1915, Bol. Lab. Zool. Gen. Agr. Portici, vol. 10, pp. 14-15, fig. 7, worker, soldier. WHEELER, 1922, Bull. Amer. Mus. Nat. Hist., vol. 45, p. 882.

SOLDIER (AFTER EMERY): Length, 1.6-1.8 mm.; excluding gaster, 1.3 mm.; head, excluding mandibles, 0.6 by 0.4 mm.; scape 0.22 mm. Head one and one-half times longer than broad, the sides almost parallel, concave behind, occiput with a fine carina terminating at each side in a tooth which is particularly visible in profile; eyes of a single facet; clypeus projecting anteriorly but not dentate; frontal groove very short and not prolonged to the fossa which represents the rudiment of the unpaired ocellus; mandibles fine toothed; scape attaining about the middle of the length of the head; funicular segments 2 to 6 about half as long as broad. Thorax dorsally scarcely impressed at the meso-epinotal suture; declivous surface of epinotum with a membranous lamella at each side.

Head and promesonotum shining, sculptured with piligerous punctations and head with longitudinal striations; sides of thorax, epinotum, and nodes thickly punctate, opaque. Pilosity short and copious.

Yellow, head light brown.

WORKER (AFTER EMERY): Length, 0.9 mm.; head, excluding mandibles, 0.34 by 0.29 mm., being a little longer than broad, a little broader behind than in front and lacking the occipital carina and teeth. Thorax and pedicel as in the soldier except for smaller nodes.

Sculpturing as in the soldier, but only the cheeks striate.

Color as in the soldier, the head more yellow.

TYPE LOCALITY: Ghinda, Eritrea.

Oligomyrmex frontalis, new species

A species characterized in the soldier caste by the large, dentate frontal lobes which are outwardly directed.

SOLDIER: Extended length, 1.9 mm.; of thorax, excluding neck, 0.50 mm. Head in front view rectangular; including mandibles, 0.48 mm. broad by 0.73 mm. long, occipital margin emarginate and bordered except at the emargination by a carina on each side which is dentate in profile, corners broadly rounded, sides subparallel, feebly convex, anterior clypeal margin produced as a sinuate lobe which is emarginate medially; frontal lobes in the form of large, obtusely angulate, triangular lobes which curve upward and outward, completely concealing antennae insertions; frontal carinae as long as the scapes, continued backward as widely spaced, slightly convergent carinae terminating in the posterior half of the head; eyes minute and situated at a level near the distal end of the scapes; median ocellus distinct; mandibles short, stout, triangular, highly convex, and with about five short, blunt teeth; antennae nine-segmented, scapes carinate, clavate, strongly bowed, terminal funicular segment about as long as the preceding funicular segments taken together. Thorax from above piriform, the pronotum globose and over twice as broad as the basal surface of the epinotum; in side view with pronotum highly convex, a broad and well-marked meso-epinotal impression and an epinotum with basal and declivous surfaces meeting at an obtuse angle with a small tooth between. Meso-notal region with sutures and a tubercle above, suggesting vestiges of wings. Nodes of pedicel from above transversely elliptical, the postpetiole about one-third broader than the petiole; in side view the petiole triangular, with slightly concave anterior surface and rounded dorsum, postpetiole much lower. Gaster ovate, with anterior margin concave and corners obtusely angulate. Legs small and slender.

Sublucid; head densely reticulate-punctate, with reticulations becoming longitudinal striae anteriorly, pronotum reticulate-punctate, the epinotum more coarsely and deeply punctate; pedicel mostly smooth above, punctate below, gaster smooth.

Pilosity of fine, short, mostly raised hairs with scattered longer hairs especially anteriorly and on the dorsal surface of the trunk.

Brownish yellow, gaster and mandibles darker.

WORKER: Extended length, about 1.1 mm.; of thorax, excluding neck, 0.40 mm.; including neck, 0.45 mm. Head, including closed mandibles, less than one and one-fifth times longer than broad; occipital margin concave, sides feebly convex and converging anteriorly, anterior clypeal margin produced as a truncate lobe and with terminations of the clypeal carinae feebly indicated; frontal lobes feeble and convex, the antennal insertions exposed; eyes minute and at the anterior half of the sides; mandibles with fine acute teeth, narrow and triangular; antennae nine-segmented, scapes long and slender, failing to reach the occipital corners by less than half their length, terminal segment about as long as the preceding funicular segments taken together. Thorax from above with pronotum convex and about twice as broad as the basal surface of the epinotum; in side view with pronotum convex, meso-epinotal suture acutely marked, and basal surface of epinotum convex, epinotal spines short and triangular, declivous surface carinate on the sides. Postpetiole about one and one-half times as broad as petiole and transversely elliptical.

Sublucid; densely punctate except on gaster and pronotum and nodes dorsally, faint reticulations and striae on head. Pilosity of sparse, fine hairs.

Brownish yellow; callows a dirty yellow with infuscated mandibular teeth.

COTYPES: Soldiers, workers, and brood (no. 2132) of a colony taken 78 miles north of Beni in the Ituri Forest of the Belgian Congo.

***Oligomyrmex latro* Santschi**

Oligomyrmex (*O.*) *latro* SANTSCI, 1937, Rev. Zool. Bot. Africaines, vol. 30, pp. 81-82, fig. 6, soldier, worker

SOLDIER (AFTER SANTSCI): Length, 2.1 mm.; head elongated, 0.8 mm., rectangular, one-fifth to one-sixth longer than broad, the sides feebly convex, nearly straight at the anterior half, occipital margin emarginate without carinae; middle third of the clypeus with feeble carinae; mandibles with five teeth; eyes rudimentary and situated at the anterior two-fifths of the head; antennal scape slightly surpasses the middle of the head; funic-

ular segments 2 to 6 broader than long, the seventh one-fourth longer than broad and a third the length of the last segment. Promesonotum convex, the mesonotum posteriorly in the same plane as the basal surface of the epinotum and (separated by) a deep metanotal impression in which appears a membranous band; subdentate with two points. Petiole as broad in front as the epinotum, one-fourth to one-fifth longer, with its peduncle, than broad, the node above twice as broad as long. Postpetiolar node transversely oval, one to two-thirds broader than the petiole and more than twice as broad as long.

Head longitudinally striate above and very shining, the striae showing mostly on the anterior third or fourth and becoming very fine elsewhere, the striae lacking on a smooth and shining band extending from the middle of the clypeus to the position of the median ocellus; mandibles smooth; with a fine piligerous punctation, very abundant everywhere except on the temples; epinotum finely reticulate, sub-matte, the remainder smooth and shining. Pilosity very short, erect, fine, and abundant everywhere, more oblique on the legs.

WORKER (AFTER SANTSCHI): Length, 1-1.1 mm. Head one-eighth longer than broad, the sides not convex (?), occipital border feebly concave; antennal scape attaining the posterior fourth of the head, the club much better developed than in the soldier. Metanotal groove more feebly developed; pedicel proportionally as broad as in the soldier. The rest similar.

A few short striae on the cheeks; epinotum and mesosternum reticulate, punctate as in the soldier, the remainder smooth and shining with the same piligerous punctation.

Color of the soldier with the head lighter.

TYPE LOCALITY: Eala, Belgian Congo.

Oligomyrmex santschii Weber

Oligomyrmex santschii WEBER, 1943, Bull. Mus. Comp. Zool. Harvard Coll., vol. 93, pp. 363-364, pl. 15, figs. 4, 16, worker, soldier.

SOLDIER: Length fully extended, 1.7 mm. (of thorax, 0.41 mm). Head in front view with closed mandibles, 0.66 mm. long by 0.40 mm. wide. Eyes minute, mandibles five-toothed, antennae nine-jointed, a median ocellus in middle of head. Thorax from above with promesonotum globular in outline and 0.24 mm. broad; basal surface of epinotum 0.11 mm. broad, concave

between lateral carinae. Petiole from above twice as thick through node as through peduncle. Postpetiole from above distinctly broader than petiole and transversely elliptical. Gaster small and ovate. Legs short, femora and tibiae inflated.

Head in front view densely punctate, closely striate except for the smooth bicarinate clypeus and frons and merely punctate occipital corners, the corners bearing also a transverse carina, occiput striate-punctate, sides of head posteriorly shining, sparsely punctate, mandibles smooth. Thorax and pedicel densely punctate, especially laterally and on epinotum, promesonotum also striate above, dorsum of petiolar and postpetiolar nodes shining, sparsely punctate; gaster shining, with piligerous punctations. Pilosity of moderately abundant, fine, yellowish, short, reclinate hairs covering body generally, and a few longer and coarser curved hairs chiefly on thorax. Light ferruginous, appendages paler.

WORKER: Length fully extended, 1.03–1.06 mm. (of thorax, 0.30 mm.), length in straight line as they crawl, 0.55–0.64 mm. Head in front view, including closed mandibles, 0.37 mm. long by 0.26 mm. wide. Eyes minute, mandibles five-toothed, antennae nine-jointed. Meso-epinotal suture faint, epinotal teeth distinct, acute, triangular. Postpetiole slightly less than twice as broad as petiole.

Head, thorax, and pedicel densely and coarsely punctate; clypeus bicarinate, frons of head and mandibles smooth and shining, gaster with piligerous punctations. Pilosity of moderately abundant, short, fine, and reclinate hairs with a few scattered much longer, coarser, and curved hairs chiefly on thorax and gaster. Pale ferruginous.

Near *Oligomyrmex jeanneli* Santschi and of comparable size in soldier and worker, but *jeanneli* soldier has 10-jointed antennae, nothing is said in the description about pre-occipital carinae, and the epinotum is unarmed. The worker *jeanneli* has mandibles four-toothed, head finely striolate, epinotum unarmed, and is in other ways different.

TYPE LOCALITY: Khor Aba on the Nile-Congo watershed south of Yei, Anglo-Egyptian Sudan.

Oligomyrmex thoracicus, new species

A species characterized by the rectangular head of the soldier,

bearing occipital carinae, and by the irregularities of the meso-metanotal area of the thorax, suggesting the female caste.

SOLDIER: Length extended, 2 mm.; of thorax, 0.63–0.67 mm. Head in front view rectangular, including mandibles, 0.55–0.58 mm. broad by 0.84–0.91 mm. long; occipital margin broadly impressed medially, corners rounded, each side of occiput with a pre-occipital carina occupying most of that side; sides sub-parallel, being slightly broader posteriorly; anterior clypeal margin sinuate, lacking teeth but emarginate medially, the clypeus with a pair of low carinae converging posteriorly; eyes minute, convex, situated at a level just behind the middle of the scapes; a single median ocellus of nearly the same size occurs at the posterior end of a groove extending back from the fossa of the frontal area; frontal lobes small, convex, not raised, diverging posteriorly; mandibles short, triangular, highly convex, and with fine, stout, acute teeth; antennae nine-segmented, scapes bowed, feebly clavate, funiculus with a two-segmented club whose penultimate segment is less than one-third the length of the terminal segment, the two taken together longer than the funiculus. Thorax from above with a short, convex, raised "neck," the remainder of the pronotum forming a rounded gibbosity slightly broader than long, meso-epinotal region about one-third breadth of pronotum; thorax in side view with pronotum rising steeply to a broad convexity, thence descending quite evenly to the slight meso-epinotal impression; epinotum from above with a pair of broadly divergent, triangular teeth, with even concavity between; epinotum in side view rising slightly from the meso-epinotal impression, basal and declivous surfaces forming a broadly obtuse angle. Thorax in the meso-metanotal region with irregularities suggesting the female thorax, including apparent wing vestiges. Petiole from above with thin, transverse node rising steeply; in side view the node forms a slightly acute summit to the triangular petiole, the ventral surface largely plane and terminating anteriorly in a minute tooth. Postpetiole from above with transversely elliptical node which is about twice as long as that of the petiole and about one-fifth wider; in side view evenly convex above and distinctly less high than the petiole. Gaster in contracted state about as long as the thorax, ovate, impressed medially to receive the postpetiole and with rounded, obtuse, anterolateral angles. Legs small and slender.

Shining; head finely striate-punctate, the striae tending to

thin out towards the occiput and sides posteriorly; mandibles smooth except for piligerous punctations and striae at the base. Thorax, epinotum, and pedicel densely and more coarsely punctate except for dorsal surfaces of pronotum and pedicel which are largely smooth; gaster smooth but for piligerous punctations. Pilosity of fine, reclinate, and scattered hairs generally distributed and much longer and more upright hairs which tend to occur in clusters in the clypeal and pronotal regions, on the nodes of the pedicel and at the gaster distally.

Bright ferruginous with funiculi and legs brownish yellow.

WORKER: Extended length, 1.0–1.2 mm.; of thorax, 0.37–0.40 mm. Head in front view with mandibles closed, 0.32–0.36 mm. wide, by 0.40–0.42 mm. long, length to anterior clypeal margin, 0.36–0.37 mm.; occipital margin truncate, broadly and feebly impressed; sides evenly convex; anterior clypeal margin produced as a truncate lobe with a pair of low carinae converging posteriorly between the frontal lobes; eyes minute, convex, situated at a level behind the middle of the scapes; mandibles triangular, five-toothed, the apical tooth distinctly the longest and acute; antennae nine-segmented, scapes long and slender, extending about two-thirds the distance to the occiput, funiculus with a two-segmented club much longer than the remainder of the segments taken together. Thorax from above with well-developed “neck” from which the remainder of the pronotum rises steeply, this latter margin anteriorly being evenly convex, the pronotal sides also convex and converging posteriorly, basal surface of epinotum about half as wide as pronotum; thorax in side view with pronotum rising anteriorly as a sharp convexity and descending gradually to the small but distinct meso-epinotal suture; basal surface of epinotum continuing smoothly to feeble epinotal teeth; declivous surface concave and carinate on each side. Petiole short and high, with convex node, and convex ventral surface terminating anteriorly as a minute tooth. Post-petiole lower but with elliptical node which from above is longer and about twice as broad. Gaster ovate and shorter than thorax with epinotum. Legs moderately long and slender.

Shining; head smooth but for piligerous punctations and a few short striae anteriorly; pronotum above smooth; epinotum densely and coarsely punctate, pedicel less markedly punctate; gaster smooth. Pilosity of fine, short, reclinate hairs and scat-

tered, much longer hairs, especially in the clypeal area, on the thorax and on the gaster posteriorly.

Yellowish brown, the head and gaster medially darker; legs and funiculi brownish yellow.

COTYPES: Soldiers and workers of a colony (no. 2083) taken February 17, 1948, just within Uganda at Busnia on the Kenya-Uganda border.

Oligomyrmex erythraeus is a closely related species whose soldier and worker measurements as given by Emery are smaller in all dimensions. The soldier head of *erythraeus* has sides straight to concave and a dorsal surface similar; its petiolar node is also thicker above; the worker differs in head and pedicel proportions.

BIOLOGY

A large clay termitarium (*Macrotermes natalensis*?) on the game plains of Kenya close to the Tanganyika border (latitude 1° 25' S., longitude 35° 10' E.) was the site of a colony from which soldiers were taken on several occasions in January and February, 1948. The ants were found near the base on a side shaded by nearby bushes and low trees. Mostly they were in the top 2 or 3 cm. of soil, under leaves, and doubtless had chambers extending much deeper into the base. The type colony at Busnia, just within Uganda on the Kenya frontier, nested in rotted wood at the base of a tree. The tree with a few bushes constituted an uncultivated island in a banana plantation. The rotted wood fragments were buried under a loose cover of fallen leaves and humus, creating high and stable relative humidity conditions. Tunnels 0.7 mm. in diameter perforated the wood and connected cells in which the ants had their brood. One cell was about 6 mm. in diameter, and its walls were brownish in color, contrasting slightly with the more reddish untouched wood. There was no evidence of mold on the walls, however, and the color may have been due to the excretions of the ants. The 6-mm. cell contained worker and female pupae, the latter being 3.3 mm. in length, and a few larvae which could have been only female, being 1.8-2.3 mm. long. Early worker pupae were enclosed in the larval skin, the latter being 0.9 mm. long. The female larvae were as plump as those of *Atta*, one 1.8 mm. long having an abdominal diameter of 1.1 mm. and a head capsule of 0.25 mm. situated completely on the ventral side; no hairs were apparent. Worker larval skins on the other hand were covered with short hairs,

bifurcate or trifurcate apically. In the small sample of the colony that was collected, the 6-mm. cell, there were seven soldiers and 16 workers. Additional specimens were taken in the vicinity. These would markedly lower the proportion of soldiers to not more than one in 10 or 20 and perhaps to as little as one in 50.

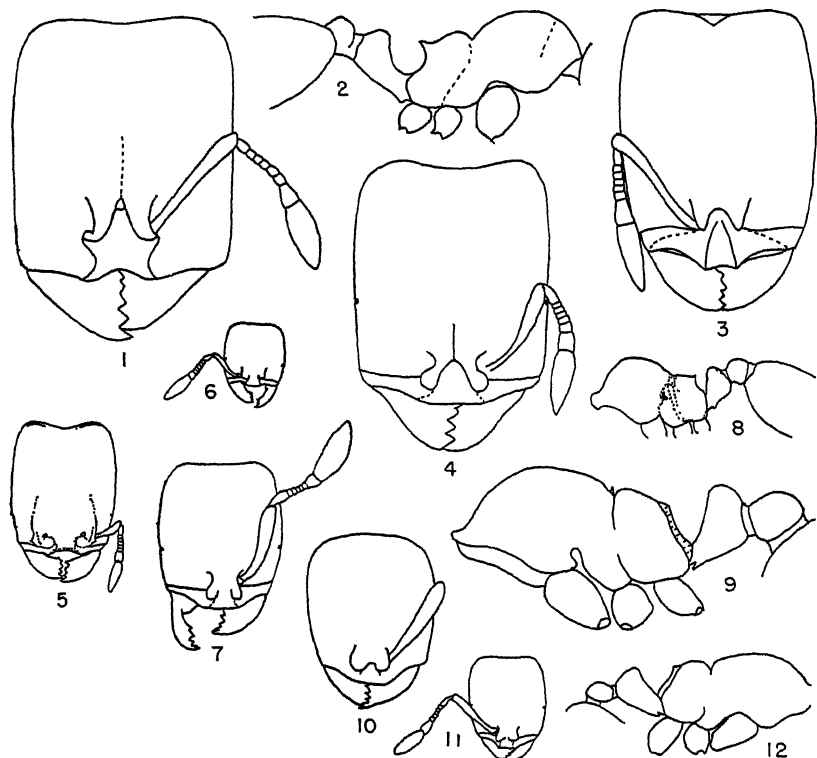


FIG. 1. Outline of head of soldier of *Oligomyrmex alluaudi* Santschi (after Santschi, 1914).

FIG. 2. Outline of thorax and abdomen of soldier of *Oligomyrmex angolensis* Santschi (after Santschi, 1914).

FIG. 3. Outline of head of soldier of *Oligomyrmex angolensis* Santschi (after Santschi, 1914).

FIG. 4. Outline of head of soldier of *Oligomyrmex latro* Santschi (after Santschi, 1937).

FIG. 5. Outline of head of soldier of *Oligomyrmex frontalis*, new species.

FIG. 6. Outline of head of worker of *Oligomyrmex frontalis*, new species.

FIG. 7. Outline of head of worker of *Oligomyrmex latro* Santschi (after Santschi, 1937).

FIG. 8. Outline of thorax and abdomen of soldier of *Oligomyrmex frontalis*, new species.

FIG. 9. Outline of thorax and abdomen of soldier of *Oligomyrmex latro* Santschi (after Santschi, 1937).

FIG. 10. Outline of head of worker of *Oligomyrmex erythraeus* Emery (after Emery, 1915).

FIG. 11. Outline of head of worker of *Oligomyrmex thoracicus*, new species.

FIG. 12. Outline of thorax and abdomen of worker of *Oligomyrmex latro* Santschi (after Santschi, 1937).

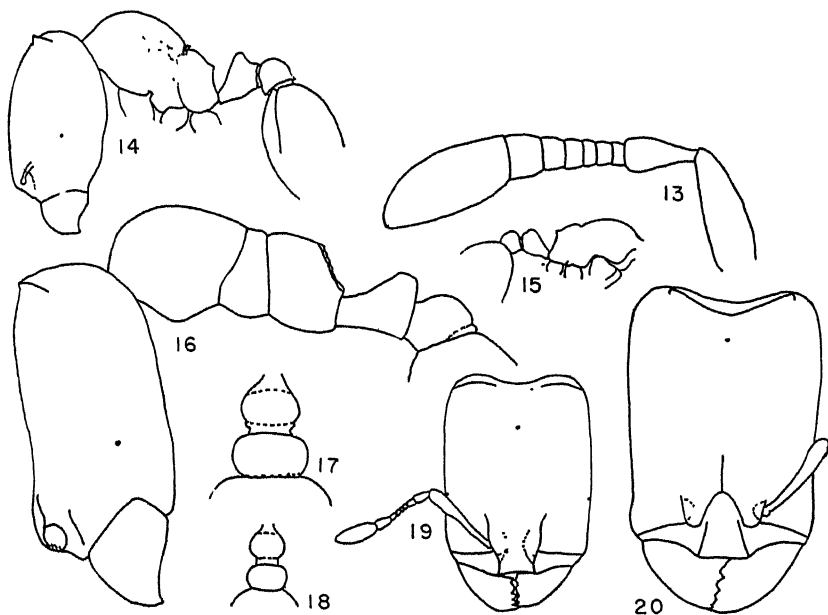


FIG. 13. Outline of antenna of soldier of *Oligomyrmex latro* Santschi (after Santschi, 1937).

FIG. 14. Outline of body of soldier of *Oligomyrmex thoracicus*, new species.

FIG. 15. Outline of thorax and abdomen of worker of *Oligomyrmex thoracicus*, new species.

FIG. 16. Outline of body of soldier of *Oligomyrmex erythraeus* Emery (after Emery, 1915).

FIG. 17. Outline of pedicel from above of soldier of *Oligomyrmex erythraeus*, Emery (after Emery, 1915).

FIG. 18. Outline of pedicel from above of worker of *Oligomyrmex erythraeus* Emery (after Emery, 1915).

FIG. 19. Outline of head of soldier of *Oligomyrmex thoracicus*, new species.

FIG. 20. Outline of head of soldier of *Oligomyrmex erythraeus* Emery (after Emery, 1915).

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STUDIES ON CENTRAL AFRICAN ANTS OF THE GENUS *PSEUDOLASIUS* EMERY (HYMENOPTERA, FORMICIDAE)¹

BY NEAL A. WEBER AND JANET L. ANDERSON²

While the senior author was biologist to the Central African Expedition of the American Museum of Natural History, several colonies of the rare genus *Pseudolasius* were collected. In the African literature are but six references to members of this genus. The ants are seldom observed, since they are hypogeic, probably tending coccids on the roots of plants as do their Neotropical congeners, *Acropyga* subgenus *Rhizomyrma*, which they closely resemble.

The present article, in addition to adding new biological data, demonstrates for the first time statistically in this genus a true dimorphic condition in the worker caste.

The ants are small, pale yellow, and blind or with eyes reduced to a vestige in the form of a slit or a minute spot. As in *Acropyga* (Weber, 1944), the surface of the body is smooth and devoid of spines which might impede their passage through the soil. They have been taken from the stomachs of toads (*Bufo superciliaris* and *polycercus*) and attending coccids (*Pseudococcus citri*) about the roots of coffee.

CLASSIFICATION

Pseudolasius was established by Emery in 1887 for *Formica familiaris* F. Smith, of Celebes, after reexamination of Smith's type specimen, and this genus has been accepted by all subsequent

¹ Aided by the Brayton Wilbur Fund of the American Museum of Natural History.

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students. *Formica* was in Smith's day a receptacle for a great assemblage of heterogeneous ants, and the two genera now are considered unrelated.

The worker was characterized by Wheeler (1922) as "small, polymorphic, the head of the major being large and differently shaped from that of the minor," and Emery (1925, p. 213) referred to "dimorphism plus ou moins apparent." While resembling *Acropyga* in reduction of eyes, color, and general habitus, *Pseudolasius* as a rule is larger and has a more cordate head. Both genera are tropical except that the Neotropical region lacks *Pseudolasius* and contains one *Acropyga* subgenus, *Rhizomyrma*. The worker is more like the worker of the Holarctic *Lasius* and especially its subgenus *Acanthomyops*, but the former has eyes, if any, in front of the middle of the head and has very short palpi, both maxillary and labial having three segments. Other morphological characters make separation of *Pseudolasius* and *Lasius* easy, and there is in addition no overlapping geographically. *Lasius* is entirely Holarctic; *Pseudolasius* is known from Indo-Malaya, Papua, Australia, and Ethiopia. In Africa they are known only from within 5° or 10° on either side of the Equator. Arnold's great South African monograph does not mention them.

The African species are:

Pseudolasius bucculentus Wheeler

Type locality: Medje, Belgian Congo

Pseudolasius bufonum Wheeler

Type locality: Medje, Belgian Congo

Pseudolasius gowdeyi Wheeler

Type locality: Entebbe, Uganda

Pseudolasius myersi Weber

Type locality: Imatong Mountains, Anglo-Egyptian Sudan

Pseudolasius weissi Santschi

Type locality: Brazzaville, French Congo

Pseudolasius weissi sordidus Santschi

Type locality: Aburi, Gold Coast

Other locality: Akenge, Belgian Congo

Pseudolasius myersi occipitalis, new subspecies

MAXIMA WORKER: Length, 3.9–4.4 mm.; length of the thorax, 1.2–1.3 mm. Head in front view, excluding mandibles, barely longer than wide, occipital margin broadly and distinctly impressed, sides strongly convex, anterior clypeal margin convex;

mandibles six toothed; eyes minute spots or slitlike; antennal scapes clearly shorter than the occipital angles. Thorax in side view convex with distinct meso-epinotal impression; from above the pronotum appears about one-third wider than the epinotum; petiole bidentate above, with broad medial impression.

Sub-lucid, integument minutely and shallowly reticulate; pilosity of scattered upright yellowish hairs and an abundant, appressed pubescence.

Pale brownish yellow.

MINIMA WORKER: Length, 2.5-2.8 mm.; length of the thorax, 0.9-1.0 mm. Head proportionately smaller, with occipital margin less impressed than in maxima caste; eyeless, sculpturing as in maxima, pubescence less abundant, color similar.

BROOD: Eggs elliptical, white, 0.18-0.20 mm. wide by 0.39-0.41 mm. long. Larva slender, hairs generally compound, mostly multifid, the longest in a 1.5-mm. larva about 0.03 mm. The larvae are white or slightly brownish with an easily observable dark intestinal mass about the level of the fifth to ninth segments. They are covered with bristly hairs which are best seen in the middle of the segments rather than in the trough of the segmental constrictions. These hairs, on examination under oil immersion, at a magnification of about 900 times, are seen to consist of a basilar scale or articulation socket and a branched stalk. The stalk divisions seem to be primarily of two types, one in which the stalk is thin and branches at the top only, the other in which the stalk is thicker and branches irregularly from shortly above the basal scale to the apex, the latter being divided into several branches. Pupae in a related Congo form are naked.

TYPE LOCALITY: Busnia, just within Uganda on the Kenya-Uganda border, February 17, 1948.

From cotypes of *myersi* the present form differs largely in having the occipital margin more deeply impressed and a distinctly duller and less bright yellow color. The pubescence of *myersi* appears less conspicuous or less abundant. The other known African species are recorded with five teeth.

DIMORPHISM

When the type colony was collected, the differences in size of the workers were striking, and dimorphism was clearly suggested. The descriptions, figures, and graphs establish the fact.

The general shape of the head of the maxima worker is cordate,

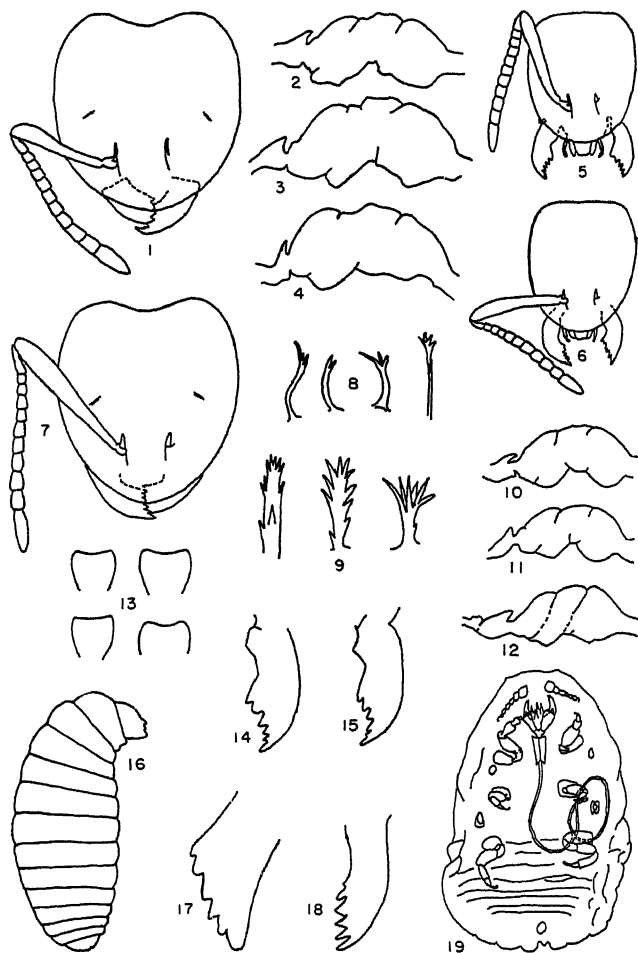


FIG. 1. Outline of worker maxima head.

FIGS. 2-4. Outlines of worker maxima thorax and petiole.

FIGS. 5, 6. Outlines of worker minima heads.

FIG. 7. Outline of worker maxima head.

FIGS. 8, 9. Outlines of larval hairs.

FIGS. 10-12. Outlines of worker minima thorax and petiole.

FIG. 13. Outlines of worker petiolar scales, minima on the left, maxima on the right.

FIGS. 14, 15. Outlines of worker mandibles.

FIG. 16. Outline of larva.

FIGS. 17, 18. Outlines of worker mandibles, inner view (left) and outer view (right).

FIG. 19. Ventral view of coccid taken with the ants and possibly associated with them.

All specimens figured are from the type colony of *Pseudolasius myersi occipitalis*.

with the occiput sharply impressed medially and with broad occipital corners. The length-width head ratio, excluding the mandibles, is 1.07:1.0. The antennal scapes distinctly do not reach the occipital corners. Eye vestiges appear only in the maxima worker caste. In 11 of 12 specimens observed, the eyes were definite and outstanding as puckered dark slits on the lateral part of the head about one-half of the total distance from the occipital margin. In the twelfth specimen the right eye was very faintly distinguishable as a wrinkling or puckering, and the left eye was entirely absent. The mandibular teeth appear to be constant in number. Twelve maxima workers were observed, all of which had six teeth. No workers were observed to have four, five, or seven teeth, each of the six teeth was well defined, and none appeared rudimentary. The apical tooth is usually longer and more conic than the other five, which are triangular or saw-tooth shaped. The integument is shiny and appears quite smooth under low powers with the exception of the hairs. The workers are light brownish yellow in color.

The head of the minima worker has rather flattish occipital corners and a slight median impression. The head length-width ratio is 1.15:1.0. The antennal scapes distinctly exceed the occipital margins. No trace of any sort of eye vestiges was observed in the minima worker. Twenty-six workers were examined for eye traces, and none was found. This is taken to be characteristic, although there may be rare cases of eye vestiges in the minima worker that were unobserved. The mandibles of 57 minima workers were observed and all found to have six teeth similar in structure to those of the maxima worker.

The total length of each ant was measured from mandibles to abdomen tip, with some attempted correction made for those curled or bent to obtain more accurate data for the total length. The thorax length was also measured from the anterior pronotal margin to the posterior episternal angle. The thorax length is a more reliable criterion of dimorphism than total length because no measurement estimations are necessary. It also is more characteristic, because some of the ants had unusually short gasters with normal-sized head and thorax, a condition which is still unaccounted for.

The thorax measurements (fig. 20) are seen to fall distinctly into only two classes. The small worker shows some variation in thorax length, which is typical of a normal distribution curve,

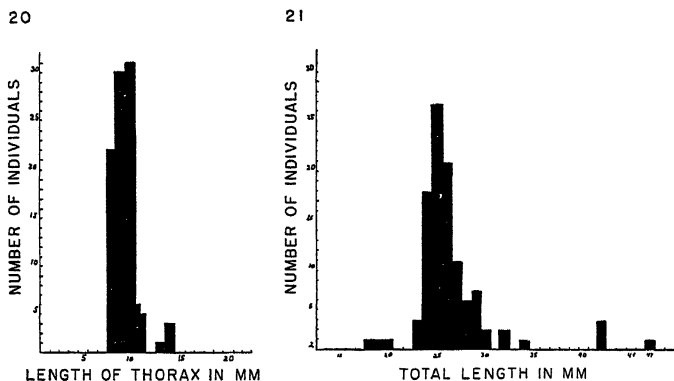


FIG. 20. Graph of thorax lengths, in millimeters, showing dimorphism of the worker caste in *Pseudolasius myersi occipitalis*.

FIG. 21. Graph of total lengths, in millimeters.

a large per cent of the whole falling in the middle, and a small fraction in the extreme, values. The large workers were unfortunately few but have quite constant thorax length despite a large variation in total length.

The second graph is for total length (fig. 21). Three minima ants with the short gasters have the total length much below the acceptable extremes, while their thorax length was normal. The total length of the minima worker as graphed shows a typical distribution curve, as does the thorax length, although there is more tendency to be spread out in the higher values than in the low ones. The maxima worker total length varies to such an extent that unless more specimens were observed the establishment of dimorphism against polymorphism on this basis alone would be open to considerable criticism. However, these measurements coupled with the thorax measurements, which are consistent, permit dimorphism to be established as a definite characteristic.

BIOLOGY

The Kenya-Uganda border at the colony site (less than latitude 1° N. of the Equator) is a grass woodland under intensive cultivation by a large native population. In a banana plantation at the side of the road an island consisting of a tree surrounded with a few bushes was left uncultivated. The colony lived in the damp tangled mass of leaves and soil about the roots of the bushes. The tangle, together with the lack of time, prevented

careful dissection, and as the soil was overturned the workers quickly scurried about, many carrying their brood. They avoided the light and took refuge under debris or quickly tunneled into the loose soil.

The maxima caste, strikingly larger than the minima, was far in the minority, and it was estimated that not more than one in 50 workers was a maxima. Some of the brood were kept in cells in decayed, buried fragments of wood. In at least one instance, larvae of similar size were in the same cell. A coccid taken with the ants may well have been associated with them. Anastomosing with the *Pseudolasius* chambers were chambers of a new species of *Oligomyrmex* (*thoracicus* Weber).

The vegetative island, while the site of the nest, was probably only part of the area used by the colony. Tunnels probably extended into the surrounding banana plantation, and it is possible that the ants tended coccids on the banana roots.

Appearance and behavior of the ants were exactly similar to those of the related genus *Acropyga* of the subgenus *Rhizomyrma* which the senior author studied in the Neotropical region (Weber, 1944), except for the presence of a maxima caste. The latter ants were found nesting in a similar manner and tending coccids under cacao, coffee, and banana plants.

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FIVE NEW GENERA OF TERMITES FROM SOUTH AMERICA AND MADAGASCAR (ISOPTERA, RHINOTERMITIDAE, TERMITIDAE)

BY ALFRED E. EMERSON¹

We must now assume that a high proportion of the existing genera of termites are known. A few based upon described species are named in a catalogue of the termites of the world by T. E. Snyder (1949, Smithsonian Misc. Coll., no. 112). Those described below are founded upon new species that accumulated as the result of several expeditions. The author is indebted to Karl P. Schmidt and E. R. Blake of the Chicago Natural History Museum, to Neal A. Weber of Swarthmore College, and to Harold Kirby of the University of California for most of these specimens.

Some of the new species here described have been studied by Dr. Muzaffer Ahmad and incorporated into a forthcoming comprehensive analysis of termite phylogeny. Nine additional new genera from a collection made in 1948 by the author in the Belgian Congo await future description.

Including all of these undescribed genera, the order of living Isoptera is now divided into five families, 153 genera, and three additional subgenera. The Mastotermitidae has a single genus and species. The Kalotermitidae has 11 described genera, and a few more will doubtless be added when the family is more thoroughly studied. The Hodotermitidae has eight genera, the Rhinotermitidae has 13, and the Termitidae has 120. The average number of species included in a genus is about 11, but of

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course there is a wide range in the size of a genus from over a hundred species to many monotypic genera.

The monotypic genus has been stigmatized as an absurdity, but the author believes that the concept has objective reality. The separations of the higher taxonomic categories are best made between living groups that are phylogenetically sharply divided, usually as the result of the extinction of intermediate forms. A genus with many species may thus be distinct from an allied genus with a single surviving species. Monotypic genera are often the surviving relicts of genera that presumably had more species in the past. They are of special interest to the student of phylogeny and often afford data enabling interpretations of geographical, ecological, geological, and evolutionary interest. A few remarks concerning these matters are included in the discussion of the following new genera.

Holotypes are deposited in the collection of the American Museum of Natural History now in the custody of the author. Paratypes are deposited in the Chicago Natural History Museum, the United States National Museum, and the Museum of Comparative Zoölogy at Harvard University.

Financial aid during the course of the studies has been received from the Dr. Wallace C. and Clara A. Abbott Memorial Fund of the University of Chicago.

Glossotermes oculatus, new genus, new species

SOLDIER (FIG. 1): Head, pronotum, and tergites brownish yellow. Labrum with a wide, light, transverse band in the middle. Head with a few scattered bristles; postmentum with a few minute hairs; pronotum with a few bristles and minute hairs around the edges; tergites with a few bristles and minute hairs on the lateral portions; tip of labrum with two bristles near the edge. Head quadrangular, somewhat flat, with somewhat convex parallel sides; a distinct eye spot behind the antennal socket on each side, a little smaller than the antennal socket and with reduced facettes barely distinguishable; a minute light gland opening visible in the middle well behind the level of the eye spots; two light spots that may be reduced ocelli a little more than the length of the eye spot above the eyes. Postmentum wide in front and narrowed in the posterior portion, about one-fourth to one-fifth its length from the rear middle margin of the head; in profile somewhat convex with a little ridge near the neck mem-

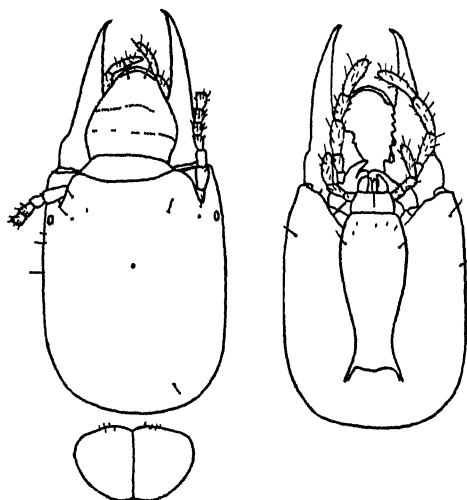


FIG. 1. *Glossotermes oculatus*, new genus, new species. Head and pronotum of soldier from above, and head of soldier from below.

brane. Antenna with 13 articles, the apical article much narrower than the preceding one, the third about equal to the second, the fourth shorter than the third. Postclypeus distinct, about three times as wide as long. Labrum very wide, sides rounded; a thin hyalin lip at the tip. Mandibles wide at the base and tapering to a sharp tip that is only slightly hooked; outer edge of left mandible nearly straight; outer edge of right mandible slightly curved inward; both mandibles with a notch where the distinct basal portion joins the apical portion about two-ninths the length of the mandible from the basal end (condyle); inner edge of right mandible smooth with a tooth-like projection about one-third of the length of the mandible from the base (condyle); right mandible narrows rapidly beyond this projection; left mandible with a finely serrate inner edge behind the tip, becoming coarser near the lower portion of the base where a large groove receives the tooth-like projection of the right mandible; edge below the groove of the left mandible coarsely serrate and edge above the groove smooth. Pronotum flatly arched, front margin distinctly notched. All tibiae with two spurs each (2:2:2).

MEASUREMENTS (IN MM.): Length of head to side base of mandibles, 1.56; height of head, 0.82; width of head, 1.10; widest width of pronotum, 0.43; narrowest width of post-

mentum, 0.22; length of postclypeus, 0.19; width of postclypeus, 0.57; width of labrum, 0.57; length of left mandible, 1.09; length of pronotum about 0.47 (could not see posterior edge under the mesonotum); width of pronotum, 0.78; length of mesonotum, 0.41; length of hind tibia, 1.09.

Described from a single soldier (holotype), Itabu Creek (1°42' N., 57°55' W.), tributary of upper New River, Acary Mountains, British Guiana, near the border of Brazil, collected by E. R. Blake, (No. 1), X.1938, in the rain forest at about 2000 feet elevation.

COMPARISON WITH OTHER GENERA: The closest genus seems to be *Psammotermes* (Rhinotermitidae), but the relationship is rather remote. *Psammotermes hybostoma* (generitype) soldier has the following differences: head and body with many long hairs; mandibles more curved and both mandibles coarsely serrate in the middle; left mandible without the inner groove at the base, and basal portion of the mandible proportionately larger and apical portion smaller; suture of postclypeus and front not so distinct; labrum large and wide, without transverse light band, tip more pointed and without hyalin lip; postmentum proportionately wider in the narrowest region; eye spot not so conspicuous; antenna with more articles; pronotum without lobed front margin; femora thicker; tibial spurs 3:2:2.

The soldier of *Glossotermes* is more primitive with regard to the eye spot and the distinct postclypeus. The soldier of *Psammotermes* is more primitive with regard to the mandibles, antenna, and tibial spur formula. The linear order of genera has practically no meaning in this instance, but I am tentatively placing *Glossotermes* first. These two genera are considered the most primitive of the Rhinotermitidae and should be tentatively placed within the same subfamily (Psammotermitinae).

GEOGRAPHICAL AND ECOLOGICAL DISTRIBUTION: The common ancestral genus of these two genera possibly evolved in Mesozoic times, because certain more advanced Rhinotermitidae (*Coptotermes*) have a world-wide distribution in the tropics and are sometimes found in warm temperate regions. The family as a whole seems to have radiated and dispersed by mid-Mesozoic times. The existence of *Psammotermes* on Madagascar as well as the African continent indicates an early Tertiary or earlier origin of the genus. *Psammotermes* is a desert and arid country group, while the single specimen of *Glossotermes* was collected in a rain forest at about 2000 feet elevation. The Termitidae (derived

from the Rhinotermitidae) underwent much adaptive radiation before the dispersal of fairly advanced groups during the first half of the Cretaceous.

***Genuotermes spinifer*, new genus, new species**

SOLDIER (FIG. 2): Head yellowish; body paler; mandibles red brown in outer two-thirds. Head with a few scattered bristles; pronotum with a few bristles; tergites with short hairs. Head elongate with straight parallel sides; hind margin somewhat curved; with a sharp conical projection in front pointed forward and the tip slightly upturned, tip above the level of the head and above the postclypeus; a sharp ridge above the base of each antenna. Postmentum slightly arched and not projecting below,

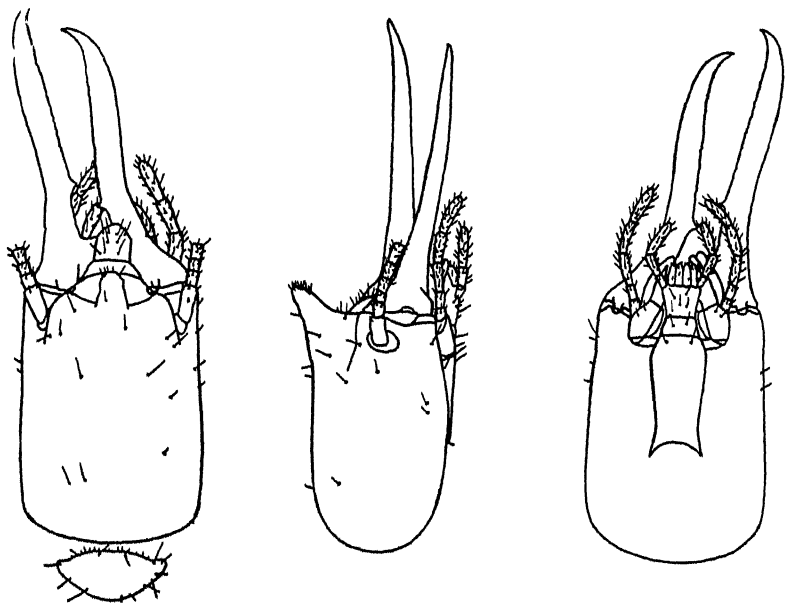


FIG. 2. *Genuotermes spinifer*, new genus, new species. Head and pronotum of soldier from above, and head of soldier from the side and from below.

proportionately fairly wide and narrowed somewhat in the middle. Antenna with 15 articles, the third a little shorter than the fourth, the fourth about as long as the second. Labrum with a convexly curved front margin and a slight angle at the junction with the straight parallel sides. Mandibles with basal third turned some-

what inward, outer two-thirds straight beyond the outward bent elbow; a tooth on the inner edge at the elbow; tips somewhat turned inward. Mandibles resemble those of *Orthognathotermes* and may function for both biting and snapping as in that genus. Pronotum profile with angle greater than a right angle between the posterior and anterior portion; front margin slightly indented.

MEASUREMENTS (IN MM.): Length of head to side base of mandible, 1.74; length of head to tip of frontal projection, 1.85; width of head, 1.26; length of postmentum, 0.65; widest width of postmentum, 0.40; narrowest width of postmentum, 0.29; length of left mandible, 1.92; width of pronotum, 0.76; length of hind tibia, 1.06.

Described from a single soldier (holotype), Urucum de Corumba (19°00' S., 57° 43' W.), Matto Grosso, Brazil, collected by Karl P. Schmidt, 14.VIII.1926, under log.

COMPARISON WITH OTHER GENERA: Closest to *Orthognathotermes* (Termitidae, Termitinae), but *Genuotermes* has more distinct mandibular teeth in the soldier, a frontal projection (resembling that of *Termes*), and lacks the bulbous projection above the base of the antenna; the postmentum is proportionately wider and shorter; the pronotum in profile does not have so sharp an angle between the anterior and posterior portions. *Genuotermes* is best placed before *Orthognathotermes* in linear order and probably represents an ancestral type that gave rise to *Orthognathotermes* in the Neotropical region.

***Spicotermes brevicarinatus*, new genus, new species**

QUEEN (FIG. 3): Head and pronotum brown, a little darker between the eyes. Head with a few long scattered hairs and no short hairs; pronotum with many long hairs; membranous sides of abdomen with numerous short hairs. Head round; portion between the ocelli slightly convex with the upper edge of the ocelli about on the level with the middle of the head. Fontanelle plate oval, in a shallow depression. Eyes fairly prominent and of medium size. Ocellus about its width from the eye, larger than the fontanelle plate and smaller than the antennal socket. Antennae broken in the specimen, the third article slightly smaller than the fourth, the fourth distinctly smaller than the second. Postclypeus prominent, arched, about twice as wide as long; with a median line; elevated above the level of the head and form-

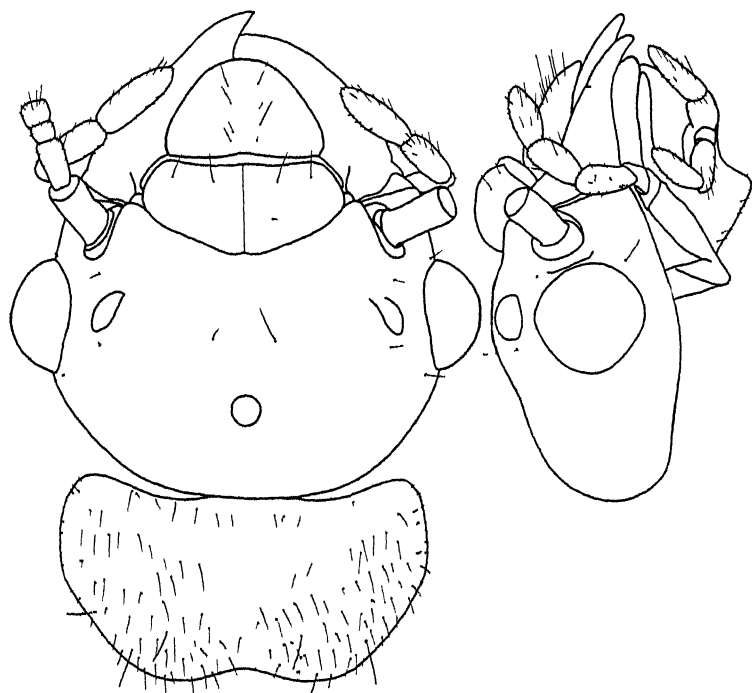


FIG. 3. *Spicotermes brevicarinatus*, new genus, new species. Head and pronotum of imago (queen) from above, and head of imago (queen) from the side.

ing a sharp angle with the front. Mandibles close to those of *Promirotermes*, but with the third marginal tooth of the left mandible not separated from the fused first and second marginal tooth by so deep a notch; second marginal tooth of right mandible distinct and separated from the first marginal tooth by an angle slightly greater than a right angle; apical teeth of both mandibles somewhat larger than the marginal teeth. *Termes* has a shorter cutting edge of the fused first and second marginal teeth of the left mandible, and the second marginal tooth of the right mandible is more reduced. Pronotum of *Spicotermes brevicarinatus* flatly saddle shaped; front margin somewhat elevated; sides rounded; hind margin emarginate. Hind margins of mesonotum and metanotum widely concave with somewhat roundly pointed posterior angles. Front tibia with three apical spurs and middle tibia with two apical spurs; hind leg

broken in specimen. Third tarsal joint of middle leg prolonged below and tip dark.

MEASUREMENTS (IN MM.): Width of head, 1.29; width of fontanelle plate, 0.06; length of fontanelle plate, 0.08; width of eye, 0.29; eye from ocellus, 0.09; length of ocellus, 0.13; width of ocellus, 0.10; length of postclypeus, 0.25; width of postclypeus, 0.53; length of pronotum, 0.50; width of pronotum, 0.96.

SOLDIER (FIG. 4): Head medium brown, darker than the rest of the body. Head nearly bare of bristles or hairs but with occasional scattered, fairly long hairs; pronotum and abdomen hairy. Head from above widest behind and sides somewhat converging towards the front; with a conical blunt vertical spike at the

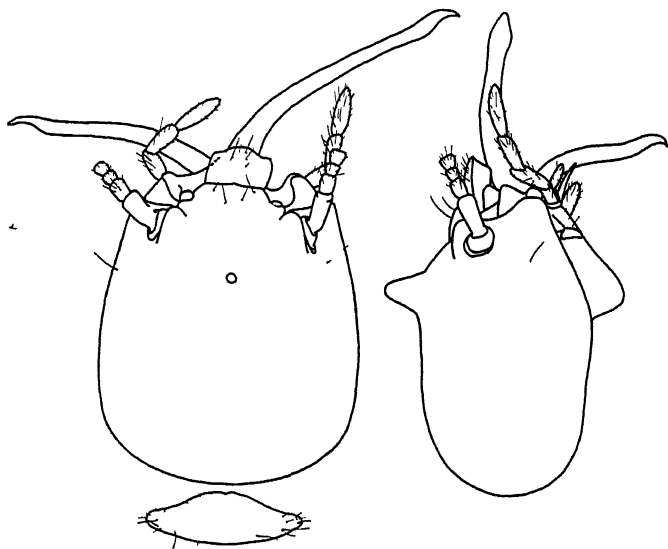


FIG. 4. *Spicoterme brevicarinatus*, new genus, new species. Head and pronotum of soldier from above, and head of soldier from the side.

junction of the front and vertex; frontal gland opening probably at the tip of the cone but minute and inconspicuous. Postmentum short, strongly arched, very prominently protruding just in front of the posterior middle portion. Antenna with 15 articles, the third shorter than the fourth, the fourth shorter than the second. Labrum wide with a slight indication of three lobes at the anterior edge. Mandibles adapted for snapping, slender,

symmetrical; bowed outward in the basal third and slightly curved inward in the outer two-thirds; tips with distinct, slightly curved hooks; molar plates each with a tooth-like projection at the base. Front margin of the pronotum somewhat emarginate; anterior portion rising sharply and forming an angle of about 90° with the posterior portion in profile. Tibial spurs 2:2:2.

MEASUREMENTS (IN MM.): Length of head to side base of mandible, 1.71–1.76; height of head from tip of spike to the tip of the postmentum, 1.35–1.50; width of head, 1.47–1.65; width of labrum, 0.35–0.39; length of left mandible, 1.91–2.12; width of pronotum, 0.88–0.96; length of hind tibia, 1.19–1.29.

Described from one queen (morphotype), many soldiers (holotype, paratypes) and workers, Oronoque River ($2^\circ 42' \text{ N.}$, $57^\circ 25' \text{ W.}$), British Guiana, collected by Neal Weber, No. 584, 22.VII.1936; many soldiers (paratypes) and workers, Itabu Creek ($1^\circ 42' \text{ N.}$, $57^\circ 55' \text{ W.}$), tributary of upper New River, Acary Mountains, British Guiana, collected by E. R. Blake, X.1938, in rain forest at an elevation of about 2000 feet.

COMPARISON WITH OTHER GENERA: *Dentispicotermes* [description taken from an undescribed species of a new genus named in Snyder's catalogue of termites, 1949, *loc. cit.*, with *D. globicephalus* (Silvestri) the generitype] soldier mandible with a short but conspicuous tooth near the middle; spike on the head more blunt; labrum with flatly convex front margin without the tendency to form three lobes as in *Spicotermes*. The general characters of color, pilosity, shape of head, shape of mandibles, shape of postmentum, and shape of pronotum are similar to those of *Spicotermes*. *Dentispicotermes* (Termitidae, Termitinae) is clearly a closely related genus possessing the more primitive character of toothed mandibles in the soldier and should be placed immediately in front of *Spicotermes* in the linear order. *Dentispicotermes* is probably a phylogenetically slightly older type in the Neotropical region.

The imago of *Promirotermes holmgreni* (Silvestri) of Africa has a proportionately longer pronotum than *Spicotermes* and a proportionately wider pronotum than *Termes fatalis* Linnaeus of Surinam and British Guiana; the fontanelle is slit shaped and long; the postclypeus is arched but is not elevated much above the level of the head. The soldier of *Promirotermes holmgreni* has a rounded front with the opening of the frontal gland below and in front of the tip; the postmentum is not prominently pro-

jected below; the antenna has 14 articles, the third longer than the second or fourth; the front margin of the labrum is concave with sharp lateral points; the mandibles are not bowed outward, but are slightly curved inward, and the tips are not so conspicuously hooked; the edge of contact with the opposite mandible near the tip is longer than in *Spicotermes*.

The imago of *Termes fatalis* Linnaeus (described by Emerson in 1925 from British Guiana under the name of *Mirotermes acutinasus*) has a proportionately longer pronotum than that of *Spicotermes* and lacks a posterior emargination; the fontanelle opening consists of a long slit; the postclypeus is not so arched and is not raised much above the level of the head. The imago of *T. fatalis* appears to be closer to *Promirotermes* than to *Spicotermes*. The soldier of *T. fatalis* has a forward-pointed frontal projection with the glandular opening close to the tip; the postmentum is long and narrow in the middle and is not projecting below; the labrum is narrow and the front margin is concave with sharp lateral points; the antenna has 14 articles, the third and fourth about equal, the second longer than the third; the mandibles are long and slender and slightly curved inward, the points slightly hooked with a fairly long edge of contact between the mandibles, the hooked tip not so distinct as in *Spicotermes*; the profile of the pronotum is without so sharp an angle between the anterior and posterior portions as in *Spicotermes*.

Quasitermes caprinus, new genus, new species

QUEEN (HEADLESS): Hind margin of pronotum straight, front margin slightly indented, and sides rounded and converging towards the rear. Hind margin of mesonotum widely and concavely emarginate with a very slight indication of an angle. Front legs broken off in specimen. Middle leg with two apical spurs and two thin spines on the outer edge of the tibia. Hind leg with two apical spurs on the tibia.

MEASUREMENTS (IN MM.): Length of pronotum, 0.53; width of pronotum, 0.86; length of hind tibia, 1.18.

SOLDIER (FIG. 5): Color of head yellow; body pale. Head with a few scattered hairs; pronotum hairy; abdominal tergites with short hairs, shorter than those on the head and shorter than the longest ones on the pronotum. Head elongate, quadrangular, sides parallel and slightly convex; frontal projection pointed forward, not very acute, reaching the level of the front margin

of the antennal socket from the side; frontal gland opening seems to be in a depression below the tip of the projection. Postmentum narrowed in the middle, in profile somewhat convex from the front to the rear. Antenna with 14 articles, the second and third about equal, the fourth shorter or about equal to the third. Labrum hardly asymmetrical, longer than wide, tip shallowly and slightly concave or angulate in the middle (turned up in figure and shows the under side), sometimes with a weak lobe between the lateral point and the middle; lateral points sharp but short. Mandibles asymmetrical and adapted for snapping; left mandible somewhat sinuate; right mandible somewhat bowed outward;

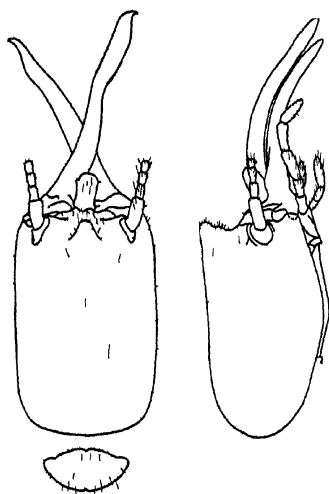


FIG. 5. *Quasitermes caprinus*, new genus, new species. Head and pronotum of soldier from above, and head of soldier from the side.

each mandible with a distinct hook at the tip. Front margin of pronotum indented; profile forming an angle a little greater than a right angle between the anterior and posterior portion. Tibial spurs 3:2:2. Middle tibia with two or three thin spines thicker than the hairs and thinner than the spurs.

MEASUREMENTS (IN MM.): Length of head to side base of mandible, 1.77–1.91; length of head to tip of projection, 1.76–1.83; height of head, 1.02–1.06; width of head, 1.18–1.22; widest width of postmentum, 0.39–0.41; narrowest width of post-

mentum, 0.21–0.23; length of left mandible, 1.94–1.95; width of pronotum, 0.75; length of hind tibia, 0.97–1.12.

Described from one headless queen (morphotype), numerous soldiers (holotype, paratypes) and workers, Manantantely (24°50' S., 46°50' E.), near Fort Dauphin, Madagascar, collected by Harold Kirby (No. T-4463), 17.VI.1935, in forest; numerous soldiers (paratypes) and workers from the above type locality, collected by Harold Kirby (No. T-4444), 15.VI.1935; numerous soldiers (paratypes) and workers, collected by Harold Kirby (No. T-4510), 3.VII.1935, near Ivoloia, 12 kilometers from Tamatave (about 18°10' S., 49°25' E.), Madagascar. Kirby's field notes under No. 4510 state: "Large mound associated with small roots of a tree at top of road cut. Estimate of size, 18 inches deep, 15 inches across, 10 inches from ground to top. Nest permeated by fine roots. Black-headed nasutes [*Nasutitermes nigrita* (Wasmann)] in lower part of nest."

COMPARISON WITH OTHER GENERA: The combination of the asymmetrical mandibles and the pointed frontal projection of the soldier indicates a natural grouping of *Quasitermes* with *Paracapratermes*, *Mirocapratermes*, and *Cornicapratermes* within the large subfamily Termitinae of the Termitidae.

The *Paracapratermes* soldier has a somewhat more sinuate left mandible than *Quasitermes*, and the lateral points at the end of the labrum are not so distinct. The imago-worker mandibles of *Paracapratermes* are a little less specialized than those of *Quasitermes* as indicated by the fact that the second marginal tooth of the right mandible is a little more distinct and the apical tooth is proportionately somewhat smaller compared to the first marginal tooth.

The soldier of *Mirocapratermes* is about equally adapted for snapping, but the left mandible is slightly more curved near the base and the right mandible is a little straighter; the labrum is more asymmetrical and is more distinctly forked with longer and sharper lateral points; the frontal projection is somewhat smaller and not so pointed. The worker of *Mirocapratermes* has a proportionately longer cutting edge on the mandible behind the first marginal tooth.

The soldier of *Cornicapratermes* has more strongly asymmetrical mandibles, and the worker mandible has a less distinct second marginal tooth.

Of this group of related genera, *Paracapratermes* is the most

generalized, *Mirocapritermes* comes next in the linear order, *Quasitermes* should be placed after *Mirocapritermes*, and *Cornicapritermes* is the most specialized. However, it would appear that both *Quasitermes* and *Cornicapritermes* are more closely related to *Mirocapritermes* than they are to each other.

GEOGRAPHICAL AND ECOLOGICAL DISTRIBUTION: The discovery of a closely related group of genera with asymmetrical snapping mandibles in the soldier caste in so widely separated regions as Australia (*Paracapritermes*), Malaysia (*Mirocapritermes*), Madagascar (*Quasitermes*), and South America (*Cornicapritermes*) indicates a mid-Cretaceous or earlier origin of the common ancestor. Termites such as these lack vagility. The weak flight, the necessity for the male and female to find each other following the colonizing flight, the climatic and biotic barriers to dispersal, and the numerous geographical and phylogenetic parallels found among termites indicate that these insects are nearly always dispersed over land connections in tropical climates. There are a few exceptions to this rule that can be adequately interpreted without negating the general proposition. In many respects the most specialized soldiers found among termites are those with asymmetrical snapping mandibles in the subfamily Termitinae (Termitidae) and the nasute soldiers in the subfamily Nasutitermitinae (Termitidae). It is of interest to note that both of these rather remotely related specialized types arose independently and dispersed during Mesozoic times. No ancient fossils have been found, so that this conjecture rests upon the circumstantial evidence of phylogenetic relationships, geographical distribution, ecological adjustments, colonization, and behavior of these insects.

***Cornicapritermes mucronatus*, new genus, new species**

SOLDIER (FIG. 6): Head yellow; body pale. Head covered with many fairly long hairs except on the extreme posterior portion; pronotum and abdomen hairy. Head thick and elongate with slightly curved sides; frontal conical projection pointed forward and extended well beyond the base of the mandibles, slightly upturned at the tip, with a small bump in front and below the tip that seems to be the opening of the frontal gland. Postmentum elongate, thin, gradually narrowed in the middle portion. Antenna with 14 articles, the second, third, and fourth about equal in length with some slight variations. Labrum

slightly asymmetrical, about twice as long as wide; tip shallowly forked with two lateral points each making an angle of about 60° and the angle between the points about 150° . Mandibles strongly asymmetrical, in general similar to *Capritermes* and *Neocapritermes* in structure and function; with a very short hook at the tip of the left mandible that may sometimes be broken off. Front margin of the pronotum slightly indented in the middle; profile concave;

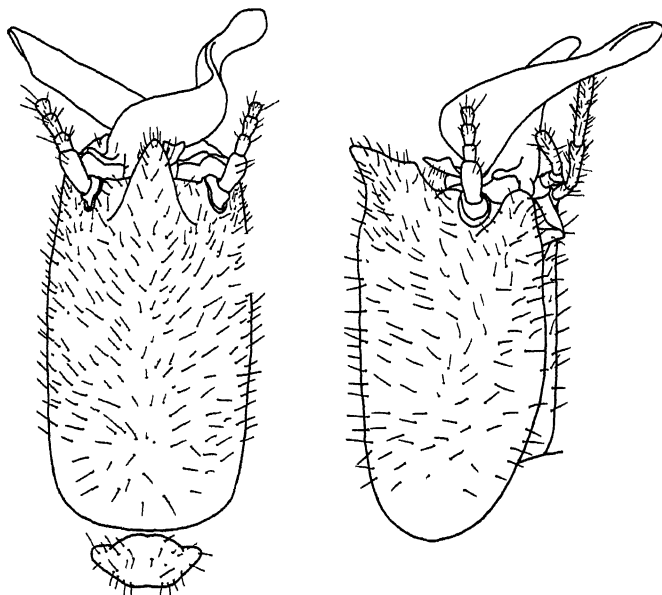


FIG. 6. *Cornicapritermes mucronatus*, new genus, new species. Head and pronotum of soldier from above, and head of soldier from the side.

angle between the anterior and posterior portions much greater than a right angle. Tibial spurs 3:2:2. Middle tibia with one or two distinct spines in the outer row. It is noteworthy to discover this character in such a specialized termite. An outer row of spines is usually considered to be a very primitive character. An outer row of spines is also characteristic of *Paracapritermes*, *Mirocapritermes*, and *Quasitermes*, but the spines are not so distinct and dark in these genera as in *Cornicapritermes*.

MEASUREMENTS (IN MM.): Length of head to tip of projection, 1.91–2.27; length of head to side base of mandible, 1.76–2.00; height of head, 0.88–1.05; width of head, 0.98–1.19; length of left

mandible, 1.24–1.40; length of pronotum, 0.29–0.31; width of pronotum, 0.59–0.70; length of hind tibia, 0.82–0.94.

WORKER: Mandibles with the apical tooth distinctly larger than the first marginal tooth; the right mandible with the second marginal tooth reduced or absent; the left mandible with the third marginal tooth separated from the fused first and second marginal teeth by a small indentation.

Described from three soldiers (holotype, paratypes) and workers, Penal Settlement (now a Forestry Station) (6°24' N., 58°39' W.), lower Mazaruni River 3 miles from its junction with the Essequibo River, British Guiana, collected by A. E. Emerson, 22.IV.1924, under a log in second-growth forest at sea level, during an expedition of the Department of Tropical Research, New York Zoological Society; a few soldiers (paratypes) and workers, Itabu Creek (1°42' N., 57°55' W.), tributary of the upper New River, Acary Mountains, British Guiana, collected by E. R. Blake, X.1938, in the forest at about 2000 feet elevation.

COMPARISONS WITH OTHER GENERA: This genus is closest to *Paracornitermes*, *Quasitermes*, and *Mirocapritermes* in the subfamily Termitinae of the Termitidae. *Quasitermes* workers have a proportionately shorter cutting edge of the fused first and second marginal teeth of the left mandible compared to *Cornicapritermes*. *Paracapritermes*, *Quasitermes*, and *Mirocapritermes* have a distinct second marginal tooth in the right mandible.

The *Paracapritermes* soldier has a less strongly curved left mandible and a more distinct hook at the tip of each mandible, and the labrum is not forked at the tip. The soldier of *Mirocapritermes* has a less strongly curved left mandible, a more distinct hook at the tip of each mandible, and the labrum is more distinctly forked at the tip with larger and sharper lateral points. The soldier of *Quasitermes* has a less strongly curved left mandible, a more distinct hook at the tip of each mandible, and the tip of the labrum is not so distinctly forked but is shallowly forked with short sharp lateral points. As noted in the discussion under *Quasitermes*, these closely related genera give circumstantial evidence of having evolved from an ancestral group that was dispersed in Mesozoic times. Of the series, *Cornicapritermes* seems to be the most specialized.

As is stated in a paper by Dr. Muzaffer Ahmad, now in press, the asymmetrical mandibles of the soldiers of the *Neocapritermes* group and the *Capritermes* group represent a remarkable case of convergent evolution of the snapping function within the subfamily Termitinae.

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A NEW *COLLICHTHYS*, WITH REMARKS ON THIS GENUS OF FISHES

BY JOHN T. NICHOLS

Fowler (1933, Bull. U. S. Natl. Mus., 100, vol. 12, pp. 361-364) synonymizes the several nominal oriental species of this genus with *Collichthys lucidus* (Richardson), as also *Laramichthys rathbunae* Jordan and Starks (1905, Proc. U. S. Natl. Mus., vol. 28, p. 204, fig. 8). In comparing two specimens from near Canton (of 96 and 101 mm. standard length) and one from the Min River, China (of 88 mm.), with five from New Guinea (of 46 to 70 mm.), and with various type descriptions and figures involved, I conclude that there are at least two quite dissimilar fishes here.

The Canton specimens, which are silvery in color, have scales on sides of the head adherent, and have lost most of those on sides of body, scales along the lower surface with specialized, supposedly luminous spots. They have 26 and 29 soft dorsal rays, 12 and 11 anal, and the second anal spine notably short, 4 and 5 times in the head. The Min River specimen has lost all color. The sides of its head are well scaled, most scales lost from the body, those remaining on the lower surfaces without specialized spots. Its dorsal soft rays number 25, anal 12 $\frac{1}{2}$, and its second anal spine is short, 4 in the head.

These three fit reasonably well both *Sciaena lucida* Richardson (1841, The zoology of the voyage of H.M.S. Sulphur, Ichthyology, p. 87, pl. 44) with 26 dorsal and 11 anal soft rays and *Collichthys fragilis* Jordan and Seale (1905, Proc. U. S. Natl. Mus., vol. 29, p. 522, fig. 4) with 28 dorsal and 13 anal. *Collichthys niveatus* Jordan and Starks (1906, Proc. U. S. Natl. Mus., vol. 31, p. 519, fig. 2), with 23 to 25 dorsal and 11 or 12 anal rays, seems more different, though close. The statement by Jordan and Starks

(1906) that *lucidus* has more dorsal rays than either *fragilis* or *niveatus* is not correct; it is described with 26, halfway between the two.

Supposing the above to be variations of *lucidus*, the New Guinea specimens differ from them in having scales more adherent on the sides of the body than on the head and, more tangibly, longer second anal spine, 2.2 to 2.9 in the head, and fewer anal soft rays, dorsal 27 to 29; anal 7 in four specimens, 8 in one. Presence or absence of specialized spots on the lower scales may be due to size or age.

Laramichthys rathbunae, with 35 or 37 dorsal and 10 anal soft rays, is very likely closer to our New Guinea fish than to *Collichthys lucidus*. Its supposedly scaleless head and relatively long second anal spine (from figure) suggest this. Its anal count is low for *lucidus*, and if it had a tropical representative in New Guinea, this might reasonably have an appreciably still lower anal and considerably lower dorsal count, the latter being much the more variable in this genus.

Günther (1860, Catalogue of fishes, vol. 2, p. 312) has confused the issue by ascribing 33 dorsal and only eight anal soft rays to *lucida* Richardson, but this is no reason for questioning the accuracy of fin counts in the type description and figure of that species, especially when the one later called *rathbunae* by Jordan and Starks might have been confused with it.

A description of the New Guinea form follows:

Collichthys novaeguineae, new species

DESCRIPTION OF TYPE: No. 18729, the American Museum of Natural History, from the Merauke River, New Guinea (as were *Harpodon*, *Polynemus*, and *Trichiurus*), August, 1941, collected by the Instituut voor de Zeevisscherij of Batavia.

Length to base of caudal, 63 mm. Depth in this length, 3; head, 3. Eye in head, 7; snout, 3.5; interorbital, 2.5; maxillary, 1.6; greatest width (at back of head), 1.6; depth of peduncle, 4; its length, 3; longest dorsal spine, 2.5; second anal spine, 2.9; dorsal rays (estimated, broken), 2.6; caudal, 1.1; pectoral, $1.2\frac{1}{2}$; ventral, 1.7.

Dorsal, X, 27; anal, II, 7. Scales, about 50.

Head heavy and globose, greatest depth above pectoral, body tapering rapidly and becoming more compressed from there to the narrow peduncle. Eye small, anterior. Sides of the head with

large pits, which appear to be open with ridges between when the delicate membrane which covers them is collapsed. Mouth large, oblique, extending well beyond the eye; tip of the lower jaw ending in a point about in line with that of the upper, otherwise the mouth is slightly included, and the upper jaw teeth are outside the lower jaw when it is closed. Good-sized, slightly curved, conical, pointed, well-spaced teeth in a single row in the upper jaw; those in the lower jaw considerably smaller and more crowded.

First dorsal spine small, one-fifth as long as the second; first anal spine small, two-sevenths the second, which is about two-thirds as long as the rays (estimated, the rays are broken). Caudal pointed. Body covered with scales which extend forward on the top of the head to well before the nostrils; those on top of the head cycloid, on the sides of the body distinctly ctenoid, those along the lower surface without specialized spots. A few larger, very delicate cycloid scales (easily overlooked) remain on the sides of the head, whence others have presumably been lost.

Color in preservative pale pinkish brown, paler below, without markings. Fins pale, a darker triangle, pointing backward, on the base of the caudal.

I realize that oriental *Collichthys* present a problem by no means solved with our scanty material for comparison, but follow Fowler in synonymizing *Laramichthys* with *Collichthys*, and for the present *C. fragilis* with *lucidus*, tentatively consider *C. niveatus* a recognizable related form, and am convinced that *C. rathbunae* and *novaeaguineae* are different.

AMERICAN MUSEUM NOVITATES

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NEW SPECIES OF *BATHYPHLEBIA* FROM ECUADOR AND PERU (LEPIDOPTERA, SATURNIIDAE)

BY JOSÉ OITICICA FILHO AND CHARLES D. MICHENER

The species of *Bathyphebia* Felder have long been included by most authors in the genus *Eacles* Hubner. The two groups are, however, abundantly distinct, not only in appearance but in structural characters. The species of *Bathyphebia* are broad winged and have the antennae of the male pectinate to the apices and those of the female narrowly so, characters not shared by *Eacles*. A full account of the numerous generic differences will be given in a forthcoming generic revision of the Saturniidae of the Western Hemisphere.

Bathyphebia johnsoni, new species

This species differs from its previously described relatives, such as *B. aglia* Felder (1874), by the cinnamon brown rather than gray ground color of the wings of the male, the yellow spot basad of the eye spot of the forewing, the yellow apical area of the forewing, and the concave outer margin of the forewing. The female differs from other known females by the eye spot of the forewing which is distinct, with a white center and a brown iris margined externally with black.

MALE: Length of body 40 mm. (38 mm. to 45 mm. among paratypes); length of forewing 58 mm. (55 mm. to 62 mm. among paratypes).

Antennae light brown, flagellum 30- to 31-segmented. Labial palpi three-segmented. Vestiture of head, prothorax, and ventral and lateral parts of thorax yellow; vestiture of mesoscutum brown, band across front end of mesoscutum gray brown, of

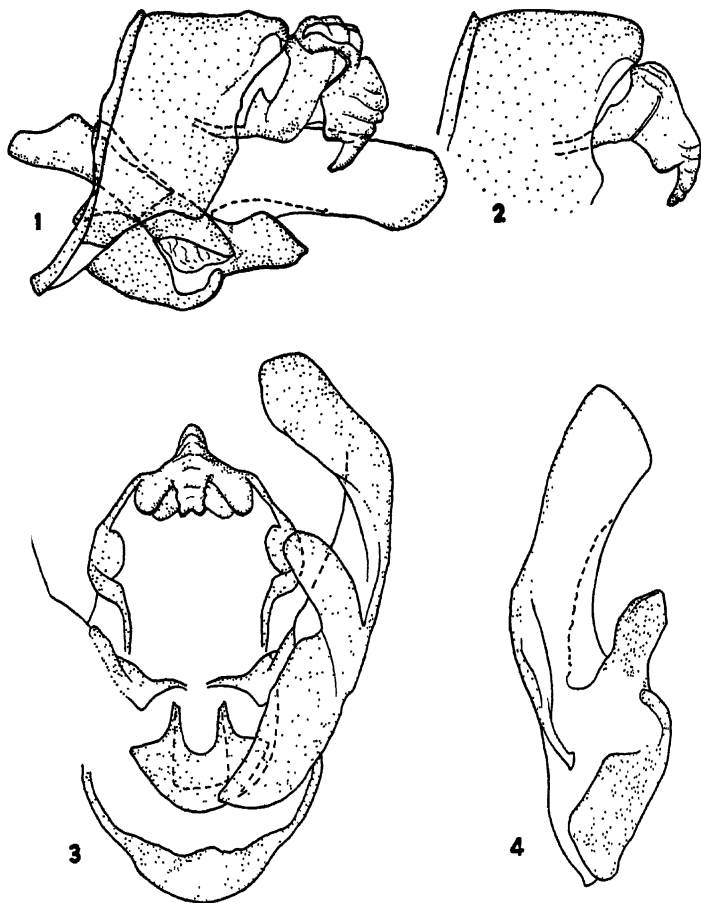


FIG. 1. Lateral view of male genitalia, right clasper removed, of *Bathyphebia johnsoni* flavior, holotype (genitalic preparation 1612, A.M.N.H.).

FIG. 2. Lateral view of uncus and upper portion of ninth tergum of *B. rufescens*, holotype (genitalic preparation 4012, U.S.N.M.).

FIG. 3. Ventral view of male genitalia, aedeagus removed, of *B. johnsoni* flavior, holotype (genitalic preparation 1612, A.M.N.H.).

FIG. 4. Inner view of harpe of same.

tegulae red brown, of posterior portion of thorax, dorsally, mixed yellow and red brown; vestiture of abdomen reddish brown dorsally, posterior margins of terga with some yellow hairs (enough in some paratypes to give the abdomen a banded appearance); lateral and ventral parts of abdomen grayish brown with two rows of small (often inconspicuous) whitish spots on each side.

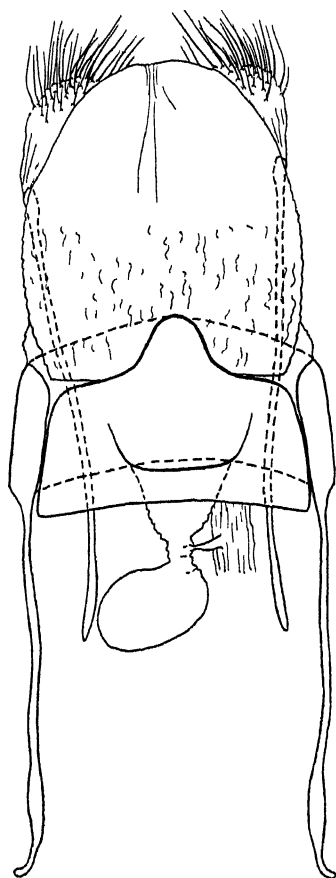


FIG. 5. Ventral view of female genitalia of *Bathyphebia johnsoni johnsoni*, allotype (genitalic preparation 204, A.M.N.H.).

Forewings with outer margins concave, so that the wings are falcate. Upper surfaces of wings with ground color cinnamon brown. Forewing with a small yellow spot at wing base, apex of discal cell marked by a translucent whitish streak or small spot which forms the center of a rather large brown eye spot which is only slightly differentiated, by its darker, duller color, from the ground color; a quadrangular yellow spot is adjacent to the eye spot basally and a shading of yellow scales distad of eye spot (in some paratypes this yellow nearly absent, in others nearly as conspicuous as spot basad of eye spot); apex of forewing, in front of

postmedian line, yellow, this yellow fading proximally into the brown of the ground color; postmedian line of forewing dark brown, shaded on outer side with pale gray; tornus with a shading of yellow scales; (wing veins of outer third of wing narrowly lined with yellow in some paratypes). Ground color of hind wings similar to that of forewings except anteriorly where it is paler and grayer, especially basad of postmedian line; eye spot as large in diameter as width of discal cell, outer ring black, central portion brown (or black in some paratypes), with a white streak which is translucent medially; postmedian line of hind wing similar to that of forewing but somewhat broader and darker, margined on outer side with pale gray shading, line fading out near anterior margin of wing. Entire forewing and hind wing beyond postmedian line sparsely spotted with dark brown dots.

Under surface of forewing dusky yellow, duller and darker (sometimes purplish brown) near costal margin; eye spot dark gray with translucent whitish central streak; postmedian line dark gray; area beyond this line and in front of vein Cu_2 purplish brown, the wing margin and streaks along the veins brown, the remaining area appearing somewhat purplish because of a scattering of elongate pale gray scales; under surface of hind wing dusky yellow, anterior third purplish, portion beyond dark gray postmedian line colored like comparable part of forewing, eye spot purplish brown with translucent streak. Under surfaces of both wings speckled with purplish brown, the spots sparsest on basal part of forewing and in areas beyond postmedian lines, densest on costal part of hind wing.

Vestiture of femora dusky above, yellow below, that of tibiae and tarsi rosy brown; epiphyses golden brown, base of each at basal sixth of tibia, apex at distal third.

Genitalia (fig. 3) similar to those of *B. aglia* but median apical lobe of uncus shorter, only feebly transversely ridged, long upper lobe of harpe narrower than in *aglia*; basal part of uncus swollen and tumid with a pair of longitudinal membranous bands (fig. 1).

FEMALE: Length of body 38 mm. (41 mm. in paratype); length of forewing 64 mm. (66 mm. in paratype).

Antennae light brown, flagellum 30-segmented. Vestiture of body yellow except for a dark gray brown band across anterior portion of mesonotum; each side of abdomen with two rows of small black spots, those of upper row centered with white.

Forewings not falcate, outer margins nearly straight. Upper



FIG. 6. *Bathyphebia johnsoni johnsoni*, upper side, holotype.

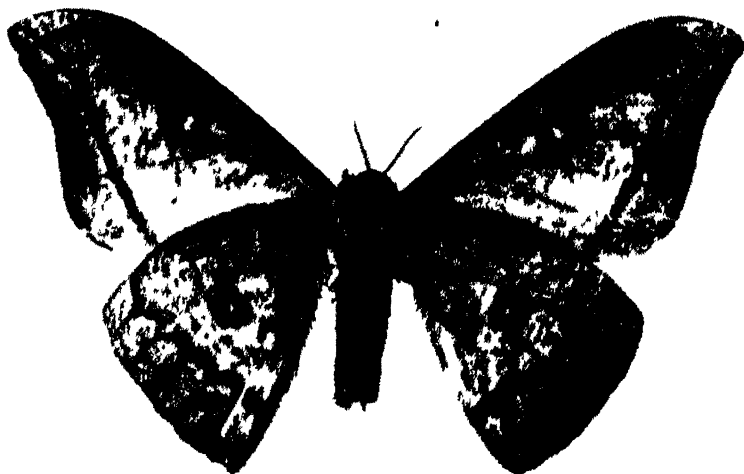


FIG. 7. *Bathyphebia johnsoni johnsoni*, under side, holotype.

surfaces of wings yellow. Forewing with costal margin dark gray brown, most broadly so basally; premedian line strongly undulate, gray, inconspicuous posteriorly; eye spot much smaller

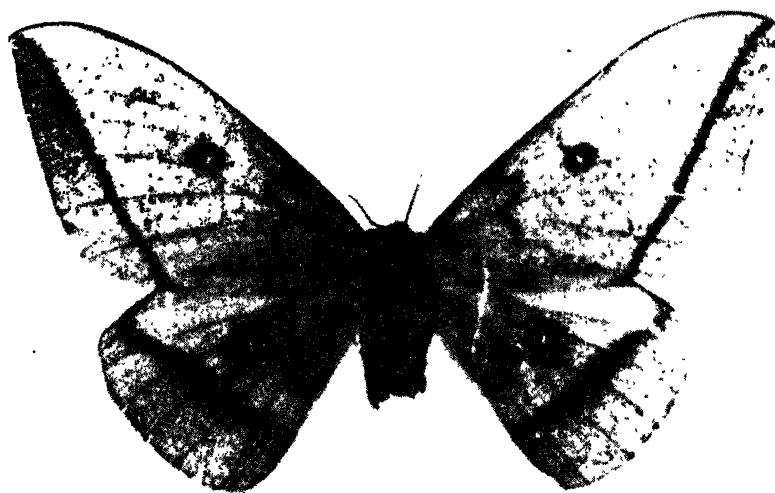


FIG. 8. *Bathyphebia johnsoni johnsoni*, upper side, allotype.

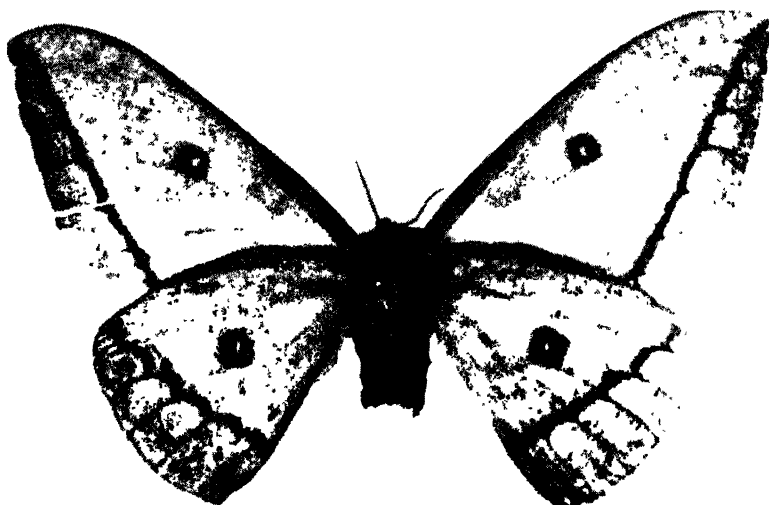


FIG. 9. *Bathyphebia johnsoni johnsoni*, under side, allotype.

than in male, dark gray brown (conspicuously brown medially in paratypes), with a small whitish central area containing a translucent streak (the paratype has the eye spot somewhat elongate

and a small brown spot in front of each eye spot); postmedian line dark gray brown, shaded on distal side with pale gray; area beyond postmedian line slightly dusky, especially towards wing apex, because of a scattering of dark scales. Hind wing with premedian line very faint and diffuse; eye spot slightly smaller than in male but otherwise similar; postmedian line dark gray brown, paler anteriorly, shaded on distal side with pale gray. Entire forewing and hind wing beyond postmedian line sparsely speckled with brownish dots.

Under surface of wings similar to upper but markings less clear-cut, premedian lines absent, postmedian lines more undulate, areas beyond postmedian lines and costal area of hind wing appearing slightly purplish except for the yellower outer margins.

Vestiture of femora dusky above, otherwise yellow, that of tibiae and tarsi brown, dusky on distitarsi.

Genitalia (fig. 5) do not appear to differ from those of *B. aglia* by any constant characters.

Holotype male (genitalic preparation 1608, A.M.N.H.), allotype female (genitalic preparation 204, A.M.N.H.), and nine male and one female paratypes: Rio Piene, Apurimac, Peru. (Two of the male paratypes have genitalic preparation numbers 205 and 1610, A.M.N.H.)

The holotype and allotype will be placed in the collection of the American Museum of Natural History in New York. Paratypes will be found in the United States National Museum and in the Oiticica collection in Rio de Janeiro.

All of the specimens of this form are from the collection of the late Frank Johnson, to whom we are indebted for the opportunity to study them, and we take great pleasure in naming this species for him.

Bathyphebia johnsoni can be divided into two subspecies. The above description is based entirely upon *B. johnsoni johnsoni*, which we judge to occur at lower altitudes than *B. johnsoni flavior*, described below.

A single topotypical male paratype (genitalic preparation 1610, A.M.N.H.) of *B. johnsoni johnsoni* has rather extensive yellow areas, especially on the hind wings, as in *flavior*.

***Bathyphebia johnsoni flavior*, new subspecies**

This form resembles *B. johnsoni* proper, differing by its smaller size and other features listed below.



FIG 10 *Bathyphebia johnsoni flavior*, upper side, holotype



FIG 11 *Bathyphebia johnsoni flavior* under side, holotype



FIG. 12. *Bathyphebia johnsoni flavior*, upper side, female.

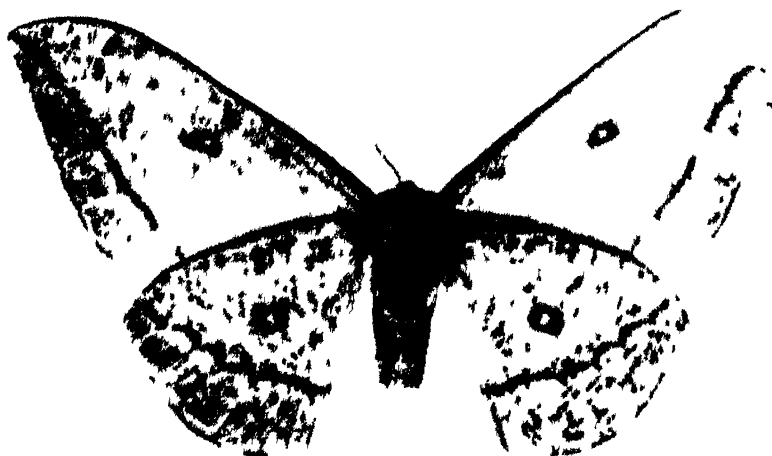


FIG. 13. *Bathyphebia johnsoni flavior*, under side, female.

MALE: Length of forewing 57 mm. (varying to 51 mm. among paratypes). Brown vestiture of body usually redder, yellow bands on abdominal terga usually more conspicuous. Forewings more

slender, with more acute apices than in typical *johnsoni*, the ground color on the average a little lighter so that a very faint, undulate, premedian line is faintly visible (this line also faintly visible in some individuals of typical *johnsoni*); yellow areas of forewing more extensive and eye spot more elongate than in most individuals of *johnsoni*. Hind wing with area basad to postmedian line largely yellow, pale yellow (to grayish yellow) anteriorly, bright yellow behind eye spot; dusky premedian line more clearly visible because of pale ground color of this portion of wing, part of wing between this line and posterior wing margin brownish red; eye spot close to and often touching postmedian line (it is sometimes close to the line in typical *johnsoni*); area near posterior apical angle of hind wing suffused with yellow. Under surfaces of wings not strikingly different from those of typical *johnsoni*, but elongate eye spot of forewing showing clearly.

A single female from Tarma, Peru, 1000 meters altitude (genitalic preparation 1611, A.M.N.H.), may be the female of this form. It differs from *johnsoni* proper by the more elongate spot of the forewing and the brown shading beyond the postmedian lines, especially on the hind wing where large brown spots are formed in cells M_3 and Cu_1 .

Holotype male, Carpish, Huanuco, Peru, 2700 meters altitude, October 12, 1946 (Felix Woytokowski) (genitalic preparation 1612, A.M.N.H.); three male paratypes: same locality and collector, October 16, 25, and 26, 1946, the last from 2100 feet altitude (genitalic preparations 1613 to 1615, A.M.N.H.)

The holotype and the female tentatively associated with it are in the collection of the American Museum of Natural History in New York; a paratype will be placed in the United States National Museum.

At first it was thought that one or the other of the forms described above might be *Eacles penelope* var. *peruvianus* Bouvier, 1927, known from a single female from Peru whose wing venation, as described by Bouvier, shows it to be a *Bathyphlebia*. However, to judge by the original description and Bouvier's later comments (Bouvier, 1931, Mém. Acad. Sci. Inst. France, ser. 2, vol. 60, p. 135), this female has markings very similar to those of *Eacles ducalis* Walker, 1855. Among the other differences, the eye spots of the hind wings of *peruvianus* are small, not enlarged and conspicuous as they are in *B. johnsoni*.

Bathyphebia rufescens, new species

This species is similar in many features of its coloration to *B. johnsoni*, but the ground color of the upper surface is paler and redder, the forewings are not falcate, the disc of the mesoscutum is provided with yellow vestiture, the under surface of the abdomen is yellow, the eye spot of the hind wing beneath is much paler than that of the forewing, and the postmedian lines on the under surface are not scalloped.

MALE: Length of forewing 60 mm.

Antennae light brown, flagellum 33-segmented. Labial palpi three-segmented. Vestiture of head, prothorax, and ventral and lateral parts of thorax yellow; mesoscutum with a transverse dusky band anteriorly, discal portion yellow, lateral and posterior margins and tegulae with brownish red vestiture; vestiture of posterior part of thorax dorsally red brown and yellow; vestiture of abdomen pinkish brown dorsally, posterior margins of terga with yellow hairs forming abdominal bands; lateral and ventral parts of abdomen yellow with two rows of small pinkish brown spots on each side.

Forewings not falcate, outer margins nearly straight, although very feebly concave near apex of vein M_2 . Forewing with a small yellow spot at wing base, apex of discal cell marked by a small white spot which forms the center of a rather large, brown, somewhat elongated eye spot which is distinctly less red than background color; a transverse yellow bar is adjacent to eye spot basally and a feeble yellow shading is present distad of eye spot; premedian line scarcely visible, slightly more brown and less red than background, most noticeable basad of yellow bar; apex of wing, in front of postmedian line, yellow, this yellow fading proximally into the brown of the ground color; postmedian line of forewing dark brown, shaded on outer side with pale gray; wing veins of outer third of wing feebly lined with yellow. Ground color of hind wings similar to that of forewings except anteriorly where it is paler, especially basad of postmedian line; eye spot smaller than in *johnsoni*, smaller in diameter than width of discal cell, black with a central white streak which is bordered with dark brown; hind wing yellowish basally; premedian line scarcely discernible, dusky; postmedian line more diffuse than that of forewing but otherwise similar and margined on outer side by a shading of pale gray scales, especially posteriorly. Entire forewing and hind wing beyond postmedian line speckled with dark brown dots.



FIG. 14. *Bathyphebia rufescens*, upper side, holotype.



FIG. 15. *Bathyphebia rufescens*, under side, holotype.

Under surface of forewing pinkish yellow, pinker in costal half of wing; eye spot dark gray with small translucent whitish central spot; postmedian line dark gray, shaded on outer side with pale gray

or whitish scales; area beyond this line reddish brown, not greatly different from ground color of upper surface; under surface of hind wing pinkish yellow, pinker towards base, portion beyond dark gray postmedian line reddish brown, slightly paler than upper surface; eye spot reddish brown with central white streak; postmedian lines of both wings straight, not scalloped as they are on under surface of *johnsoni*; under surfaces of both wings speckled with dark brown, the spots sparsest in basal part of forewing.

Vestiture of femora largely yellow, that of tibiae and tarsi pink; epiphyses brown, otherwise as in *johnsoni*.

Genitalia similar to those of *johnsoni*, upper lobe of harpe as slender as in *johnsoni*, uncus smaller, not tumid basally, and without longitudinal membranous bands (fig. 2).

Holotype male, Guayaquil, Ecuador (F. W. Goding), in the United States National Museum, bearing the genitalic preparation number 4012.

The genitalia of *Bathyphebia* seem to offer good specific characters, although there is some intraspecific variation. The only species for which a good series has been available for study is *B. johnsoni*. In this form the apex of the uncus is not always bidentate as shown in figure 3, and the median portion of the uncus does not always extend so far posteriorly as shown in the same figure. The species is readily recognized by the tumid base of the uncus, with longitudinal membranous bands. *B. aglia* Felder (1874) may be recognized by the strong transverse rugae of the uncus, extending to its base, and by the broad upper lobe of the harpe. A species tentatively identified as *B. gschwandneri* Schawerda (1925) is similar to *agli*a, but the transverse rugae of the uncus are much weaker, especially apically. In *B. rufescens* the uncus is not greatly different from that of *gschwandneri*, but the rugae are even weaker and those of the base of the uncus are oblique; also the upper lobe of the harpe is narrow, as in *johnsoni*, not broad as in *agli*a and *gschwandneri*. *Bathyphebia eminens* (Dognin) (1891) differs from the rest in many ways, among them the presence of spicules on the sac of the aedeagus and the presence of a heavily sclerotic broad inner projection from the middle lobe of each clasper.

AMERICAN MUSEUM NOVITAT²

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A NEW SPECIES OF *EACLES* FROM COLOMBIA (LEPIDOPTERA, SATURNIIDAE)

By JOSÉ OITICICA FILHO AND CHARLES D. MICHENER

The species described below was first recognized as new by the late Frank Johnson of Griffin, Georgia, after whom we take pleasure in naming it. Mr. Johnson not only recognized the new form, but through various Colombian collectors assembled all of the six known specimens, and subsequently turned them over to us for description in connection with a forthcoming revision of the genus *Eacles*. Through his generosity also, funds were available for the preparation of figures. The drawings were made by Mr. and Mrs. Jerome Rozen.

Eacles johnsoniella, new species

This strikingly distinct species is perhaps more similar externally to *E. barnesi* Schaus, 1905, than to any other. The male differs from *barnesi* by having the eye spots larger, their white centers in particular larger than in most specimens of *barnesi*; by having the background color of the median area of the forewings (area b, fig. 1) entirely yellow, not invaded by brown as in *barnesi*; by having the postmedian line (2) of the forewing more lunated than in *barnesi*, especially ventrally; by having much more gray in the apical part of the forewing (area c), and by lacking yellow (except for the fringe) along the anterior part of the apical margin of the forewing. The male genitalia are of the same general type as those of *E. ducalis* Walker, 1855, and its relatives, of which *barnesi* is one. In *johnsoniella* there is a small apical swelling on the right-hand side of the aedeagus which separates this species from both *ducalis* and *barnesi*. It differs further from its near relative, *barnesi*, by having the apex of the sacculus of the

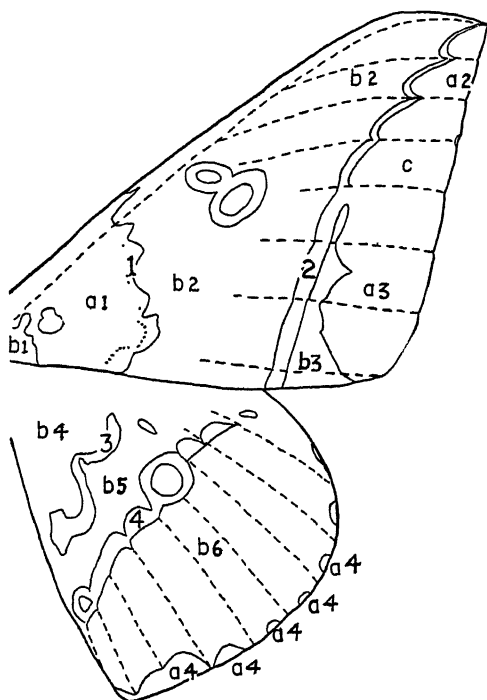


FIG. 1. Diagram of wings of *Eacles johnsoniella*, upper side.

harpe produced to an acute, heavily sclerotized process (fig. 6) instead of a short, blunt, and weakly sclerotized one.

MALE: Length of body 40 mm. (varying to 45 mm. among paratypes); length of forewing 50 mm. (varying from 48 mm. to 55 mm. among paratypes).

Antennae brown, the flagellum 41- to 44-segmented, basal 17 segments quadripectinate. Labial palpi three-segmented. Vestiture of body yellow, brown on anterior part of mesoscutum and surrounding two whitish spots on posterior part of mesoscutum (or vestiture of mesoscutum and tegulae largely brown, the white spots absent in some paratypes); dorsum of abdomen pinkish brown.

Forewings not falcate. Upper surfaces of wings as diagrammed in figure 1; areas a1, a2, a3, and a4 brown, varying among the paratypes in shade, a1 suffused with yellowish towards the outer margin in some paratypes, a2 and a3 not clearly differentiated



FIG. 2. Upper side of *Eacles johnsoniella*, holotype.



FIG. 3. Under side of *Eacles johnsoniella*, holotype.

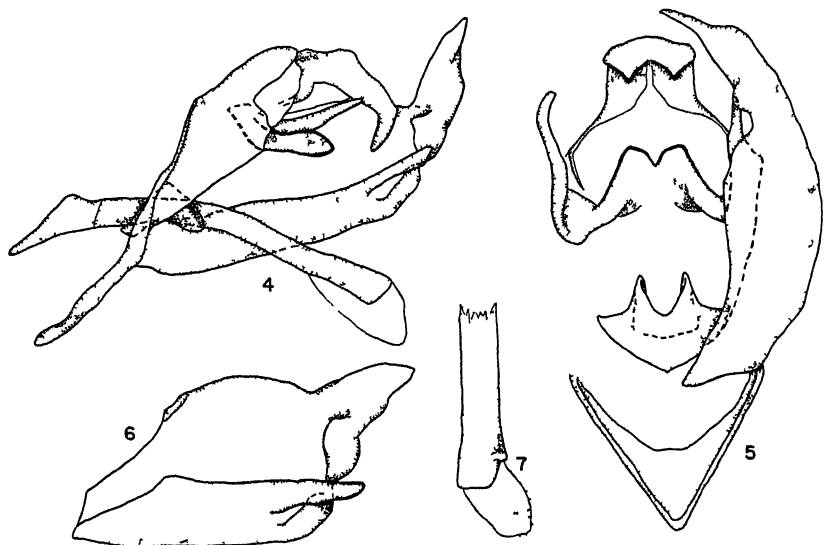


FIG 4 Lateral view of genitalia, one harpe removed, of *Eacles johnsoniella*, genitalic preparation 191, A M N H.

FIG 5 Ventral view of same, aedeagus removed

FIG 6. Inner view of harpe of same.

FIG 7. Dorsal view of apex of aedeagus of same.

from the grayish area c, the gray suffusion sometimes obscuring most of the brown in areas a2 and a3, areas b1, b2, b3, b4, b5, and b6 yellow; area b3 sometimes broken into three spots by encroachment of a3 along veins Cu_1 and Cu_2 , eye spots white, margined with brown, a small spot near base of area a1 also white, lines 1, 2, and 4 faintly grayish, margined with brown, line 3 brown, entire forewing and hind wing beyond line 4 speckled with small, dark brown dots, hind wing just basad of line 4 sometimes with a few such dots. Under surfaces of wings yellow, sparsely speckled with brown dots which are densest near costal margins of hind wings; eye spots and lines 2 and 4 as on upper surface, areas a2, a3, a4, and c brown, suffused with gray, a3 and a4 darkest.

Vestiture of femora yellow, of tibiae and tarsi brown. Epiphysis short, its base at basal fourth of tibia, its apex at distal third

Genitalia similar to those of *E. ducalis* Walker, 1855, as shown in figures 4 to 7; aedeagus with apical swelling on right side; sac of aedeagus spiculate. (The slender, upturned apex of the harpe shown in figure 4 is not a characteristic of the species,

in other specimens the harpe is broader subapically and less acutely pointed.)

Holotype male (genitalic preparation 1616, A.M.N.H.) and three male paratypes: El Centro, Colombia (one of these paratypes has the genitalic preparation number 191, A.M.N.H., another 4019, U.S.N.M.). One male paratype (genitalic preparation 1617, A.M.N.H.): Muzo, Colombia; one male paratype, Rancho Grande (Carare), Santander del Sur, Colombia, 1100 meters altitude, March 18, 1947 (Richter). All specimens are from the Frank Johnson collection. The holotype is in the American Museum of Natural History, a paratype in the United States National Museum, and a paratype in the Oiticica collection, Rio de Janeiro.

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SOME NORTH AMERICAN CHELIFERID PSEUDOSCORPIONS

BY C. CLAYTON HOFF¹

This paper is concerned with the results of a study of some North American cheliferid pseudoscorpions of the tribe Cheliferini. While the present investigation is based chiefly upon materials deposited in the American Museum of Natural History, there are included numerous records of pseudoscorpions from collections submitted for determination by numerous individuals and institutions.

SUBORDER MONOSPHYRONIDA J. C. CHAMBERLIN

FAMILY **CHELIFERIDAE** HAGEN

TRIBE **CHELIFERINI** J. C. CHAMBERLIN

Chelifer cancroides (Linnaeus, 1758)

Acarus cancroides LINNAEUS, 1758, *Systema naturae*, ed. 10, p. 616.

Chelifer cancroides BEIER, 1932, *Das Tierreich*, vol. 58, p. 235.

RECORDS: Forest Hills and Castleton Corners, Long Island, New York; Cumberland and College Park, Maryland; Rock Point, Douglas Lake, and Midland, Michigan; Rockford and Rutland, Illinois; Gainesville, Georgia; La Mesa, Dawson County, Texas; Lawrence, Kansas; Council Bluff and Newcastle, Nebraska; Fort Collins, Colorado; Independence Rock, Sweetwater River, Wyoming; Hamilton, Ravalli County, Montana; Montpelier, Idaho; Utah Lake, Utah; Britcher collection, California; Rogue River Valley and Nestsucca River, Oregon; Salmon

¹ Department of Biology, University of New Mexico, Albuquerque, New Mexico. This study was completed with the aid of a faculty research grant from the University of New Mexico.

Arm, Vancouver, Bella Caola, and Kamloops, British Columbia, Canada; Wrangell and Fairbanks, Alaska. Most of the records are from dwelling houses, a few from chicken houses. An interesting record is one from Nestsucca River, Oregon, where one male and four females were taken on June 10, 1938, by Jellison and Kohls from an eve swallow nest. The specimens from Nestsucca River are deposited at the Microbiological Institute (AP No. 14095) of the United States Public Health Service, Hamilton, Montana.

***Parachelifer persimilis* (Banks, 1909)**

Chelifer persimilis BANKS, 1909, Canadian Ent., vol. 41, p. 304.

Parachelifer persimilis CHAMBERLIN, 1932, Canadian Ent., vol. 64, p. 19; 1934, Pan-Pacific Ent., vol. 10, pp. 131, 132.

RECORDS: Numerous males and females from Santa Catalina Mountains, Mormon Lake, Santa Rita Mountains, White Mountains, and Graham Mountain, Arizona, all belonging in the collections of the American Museum of Natural History; numerous males, females, and nymphs from Colorado, including a collection from Colorado Springs by E. V. Gregg, one from Ward in Boulder County by C. L. Remington, one from Fort Collins by C. C. Hoff, one from Red Feather Lakes by Ralph Hill, one collection from Ourav, and another collection marked only "Colo."; one collection, consisting of a single male, taken by M. H. Muma from beneath a stone in Chadron State Park, Nebraska; one collection taken by Lieut. D. J. Zinn at Warm Springs Ranch, Las Vegas, Nevada; one male taken from a cerambycid beetle by W. L. Jellison of the United States Public Health Service at Hamilton, Montana; one female taken by G. F. Knowlton at Vernon, Utah; one male and one female taken by W. J. Gertsch 6 miles northeast of El Salto, Durango, Mexico, on August 10, 1947, and another collection consisting of two males taken by the same person at Catarinas, Chihuahua, Mexico, on July 25, 1947.

REMARKS: Previous to this time, this species appears to have been reported only from New Mexico (Banks, 1909; Chamberlin, 1934). The species at present is poorly defined in the literature, and it is possible that a slightly different concept may be necessary after the cotypes deposited by Banks at the Museum of Comparative Zoölogy, Harvard College, have been restudied. The species as conceived by the present writer shows a wide variation in size,

but this may be correlated with the extensive geographical range of the form. Ecologically the species appears to be confined to mountainous areas. In lieu of a complete description, the following combination of characteristics has been used in making a separation of *P. persimilis* from other described species of the same genus: eyes present; palpal tibia conspicuously shorter than the femur; femur more than 1.1 mm. in length, length:width ratio less than 5.6; tibia longer than 0.9 mm. and with a length:width ratio more than 3.5 and less than 4.1; chela without the pedicle over 1.6 mm. in length, length:width ratio more than 3.5.

***Idiochelifer nigripalpus* (Ewing, 1911)**

Chelifer cancroides var. *nigripalpus* EWING, 1911, Jour. New York Ent. Soc., vol. 19, pp. 73, 80.

Idiochelifer nigripalpus CHAMBERLIN, 1932, Canadian Ent., vol. 64, p. 19. HOFF, 1946, Amer. Mus. Novitates, no. 1318, pp. 26-28.

Hysterochelifer longidactylus HOFF, 1945, Amer. Midland Nat., vol. 34, pp. 511-515.

RECORDS: One male from Hollister, Missouri, collected by Mrs. Vitae Kite on June 5, 1938; two males and one protonymph from beneath pine bark, Kimball Lake, Minong, Wisconsin, by H. H. Ross, August 25, 1945; one female from beneath maple bark by Lewis J. Stannard at Mahomet, Illinois, on October 23, 1948; one male and one female from beneath hemlock bark at Turkey Run State Park, Indiana, by Becker *et al.*, April 25, 1948; and one male from beneath hemlock bark by Sanderson and Stannard at the location and date immediately above. All these records are based on collections of the Illinois State Natural History Survey, Urbana, Illinois.

REMARKS: The specimens from Indiana indicate that there is considerable variation in the palpal podomeres, both as to actual size and with respect to the length:width ratios. In spite of this variation, however, it is very apparent that the present specimens are conspecific with the type specimens of the species.

In order to record the variation found in the specimens from Indiana, it seems advisable to give the following measurements. One male has a femur 0.81 mm. long, 0.175 mm. wide; tibia 0.65 mm. long, 0.20 mm. wide; chela 1.30 mm. long, 0.295 mm. wide; length of hand of chela without pedicle 0.59 mm., depth of hand 0.275 mm.; length of movable finger 0.71 mm. The other male from Indiana has the femur 0.76 mm. in length, about 0.155

mm. in width; tibia 0.64 mm. long, 0.18 mm. wide; chela 1.22 mm. long, 0.27 mm. wide; length of hand 0.59 mm., depth 0.245 mm.; movable finger 0.69 mm. in length. The female has one palpal femur 0.82 mm. long, 0.18 mm. wide, while the other femur measures 0.80 mm. long, 0.175 mm. wide; tibia of one side 0.67 mm. long, 0.21 mm. wide; the tibia of the other side 0.66 mm. in length, 0.20 mm. in width; chela 1.33 mm. long, 0.315 mm. wide; hand length 0.60 mm., depth 0.29 mm.; finger length 0.76 mm.

Haplochelifer philipi (Chamberlin, 1923)

Chelifer philipi CHAMBERLIN, 1923, Proc. California Acad. Sci., ser. 4, vol. 12, p. 374.

Haplochelifer philipi CHAMBERLIN, 1932, Canadian Ent., vol. 64, pp. 17, 18, 20.

RECORDS: Three males and 19 females taken by Willis J. Gertsch on May 9, 1929, at Mill Creek Canyon, Mill Creek, Utah; one female, Richfield, Utah, August 1, 1930, and one female, City Creek Canyon, Utah, June 8, 1928, by Willis J. Gertsch; one male, Yosemite National Park, California, July, 1939, by Ernst Mayr; two females, Estes Park, Colorado, at 7500 feet, July 5, 1913, collector unknown; one male under rocks in yellow pine forest, Fort Collins Recreation Area, Roosevelt National Forest, date not given, and one male from debris in yellow pine forest, elevation 6600 feet, Rist Canyon, Roosevelt National Forest, Colorado, on September 15, 1946, by C. Clayton Hoff; and one male from litter under pinyon pines by C. Clayton Hoff near Owl Canyon, north of Fort Collins, Colorado, on November 29, 1946.

Hysterochelifer proprius, new species

Figures 1-5

MALE: Description is based on the holotype and one male paratype; each measurement of the holotype is followed in parentheses by the corresponding measurement of the paratype. Body deep golden brown in color; legs slightly lighter in color; palpi a deeper reddish brown. Body fairly stout, length 3.25 (3.3) mm. Carapace coarsely granular with numerous larger setae-bearing tubercles scattered over the surface; setae very short, subclavate; posterolateral corners bearing keels similar to those of the tergites; lateral margins anterior to the keel evenly convex, anteriorly the carapace is somewhat truncate between the

eyes, posterior carapacial margin with eight to 10 setae exclusive of setae on the keel; carapace widest across the posterior margin; 0.95 (0.93) mm. long, 1.03 (0.98) mm. wide; ocular breadth 0.47 (0.49) mm. Abdomen with tergites colored and sculptured much as the carapace; all tergites divided; tergites 1 through 10 with lateral keels, those of the anterior tergites very conspicuous and with well-developed, posteriorly directed projections, those of the posteriormost tergites becoming less conspicuous until in the tenth tergite there is no noticeable projection although the sclerotic keel is present; setae stout, subclavate, and almost cylindrical, short in the anterior tergites but becoming longer in the posterior tergites; most tergal halves with eight or nine marginal setae, including one on the keel, and in addition a median and a lateral seta anterior to those of the row. The holotype shows an anomaly with respect to the regularity of the tergites, the third tergal half of the right side being on a level with and joining medially the second tergite of the left side, leaving the second tergite of the right side somewhat wedge-shaped; the fourth half-tergite of the right side is joined medially by both the third and fourth left tergal halves. Sternites of about the same color as the tergites but a little less coarsely granulate; sternites divided; setae acuminate, little longer than those of the tergites; each half of sternite 4 with nine setae, all in a marginal row; other sternal halves usually with eight to 11 setae in a posterior marginal row and in addition usually a lateral seta in each tergal half; anterior stigmatic plates without setae, each posterior plate with one seta; pleural membranes somewhat irregularly, but finely, striated; abdomen 2.3 (2.35) mm. long, 1.44 (1.45) mm. wide.

Chelicera light golden brown in color; in general fairly stout but fingers relatively less stout; palm of hand with weak, net-like markings; setae of flagellum almost entire, slender, the shortest more than one-half as long as the longest; tactile seta SB and B subterminally denticulate, other tactile setae much longer and acuminate; length of chelicera 0.255 (0.25) mm., width of hand 0.148 (0.14) mm. Fixed cheliceral finger slender, little curved; inner surface of apical tooth with three small denticles; three retroconical denticles along the anterior end of the inner finger margin; lamina exterior wide with free margin well curved. Movable cheliceral finger gently curved; serrula exterior of 17 or 18 plates; outer finger surface sculptured in such a way that in profile it appears weakly but definitely serrate; inner margin

with a single very poorly developed denticle removed some distance from the apical tooth; subterminal lobe poorly developed and very inconspicuous; laminal seta inserted near the level of the denticle and reaching to about the tip of the galea; apical tooth well curved, terminally blunt and with a weak subdivision into cusps; galea stout, gradually narrowed distally, little curved, with five or six subterminal and terminal rami; length of movable finger 0.205 (0.20) mm.

Palpus (fig. 1) dark reddish brown in color; surfaces of podomeres densely granulate, with surface of trochanter and femur characterized by numerous seta-bearing tubercles, these especially conspicuous along the flexor margin; surface of chelal fingers smooth; setae short and inconspicuous, weakly subclavate in the proximal podomeres except the maxilla, becoming virtually acuminate on the distal podomeres; setae of maxilla acuminate. Maxilla subtriangular in shape, two subapical setae on each; a conspicuous lyrifissure near the center of the inner margin of each maxilla, length of maxilla 0.49 (0.49) mm., width 0.30 (0.32) mm. Trochanter with a conspicuous subdorsal protuberance; setae-bearing tubercles very conspicuous; pedicle wider than long; inner margin of trochanter evenly convex; length 0.51 (0.51) mm., width 0.28 (0.28) mm. Femur with poorly defined pedicle, little wider than long; flexor margin a very little concave; extensor margin flatly convex in the center, more convex near each end; femur widest at about the distal one-fifth; length 1.05 (1.04) mm., width 0.24 (0.24) mm. Tibia without seta-bearing tubercles; pedicle about as long as wide; flexor margin weakly convex, fairly well differentiated from the pedicle; extensor margin flatly convex in the central half, more convex in the region of the pedicle and the distal fourth; length 0.92 (0.86) mm., width 0.29 (0.285) mm. Chela from dorsad with both margins of hand very little convex except near basal and proximal ends; pedicle near center of base of hand; hand tapered a little towards the finger base; fingers moderately slender, gently curved; length of chela 1.50 (1.44) mm., width of hand 0.39 (0.39) mm. Chela in lateral view (fig. 2) with hand subcylindrical, both ventral and dorsal margins evenly but weakly convex; base of hand more or less symmetrical with pedicle displaced a little towards the ventral side; fingers little curved; hand 0.805 (0.81) mm. in length, holotype with hand 0.355 mm. deep; finger length 0.75 (about 0.72) mm. Movable chelal finger of holotype with 42

marginal teeth, all cusp bearing and a little retroconical; fixed finger of holotype with 41 similar teeth; teeth of both fingers distinctly worn, apparently from use; condition of the hand of the paratype precludes counting of the teeth. Sensory or tactile setae as shown in figure 2.

Legs golden yellow in color, the basal podomeres often a little darker than the distal; basal podomeres moderately granulate to strongly granulate, distal podomeres less granular; setae for the most part short, stubby, and paucidenticulate, but with a tendency to become acuminate on the flexor surface of the distal podomeres, setae of the extensor surface of the femoral parts of both first and fourth legs and the tibia of the first leg are inserted on tubercles, these latter more weakly developed than on the carapace. First leg of male with distal podomeres strongly modified; trochanter 0.21 (0.21) mm. long, 0.16 (0.155) mm. deep; pars basalis with a well-defined pedicle that is much deeper than long, flexor margin of pars basalis evenly and markedly convex, length 0.34 (0.33) mm., depth 0.195 (0.19) mm.; pars tibialis fusiform, both extensor and flexor margins conspicuously convex, length 0.43 (0.42) mm., depth 0.175 (0.17) mm.; tibia somewhat pediculate, extensor margin somewhat convex in the basal two-thirds or three-fourths, but nearly straight beyond, flexor margin markedly convex except near the base, tibia deepest at the distal three-fourths, length 0.42 (0.395) mm., depth 0.147 (0.145) mm. Tarsus (fig. 3) highly modified, with the flexor margin weakly convex; extensor margin straight in a little more than the basal half, then marked by a deep sinus that extends to the terminal spine; at the proximal end of the situation, there are one or two subcylindrical, setae-bearing tubercles; anterior terminal claw stout and strongly curved near the distal third or fourth; posterior claw slender, strongly bent near the middle, with an acute accessory tooth inserted just distal to the point of angulation; tarsus 0.38 (0.37) mm. long, the tarsal spine not being included in the measurement; tarsus with greatest depth 0.136 (0.130) mm. Fourth leg with well-marked spur on coxa, coxal sacs elongated with the lateral half of each with the wall thrown into folds; trochanter 0.32 (0.32) mm. long, 0.185 (0.173) mm. deep; pars basalis subtriangular in shape, 0.25 (0.253) mm. in length, 0.17 (0.155) mm. deep; pars tibialis with extensor margin well rounded, flexor margin nearly straight, 0.67 (0.65) mm. long, 0.27 (0.25) mm. deep; entire femur 0.79 (0.77) mm. long; tibia relatively slender,

flexor margin evenly and gently convex, extensor margin convex in basal third but straight or even a trifle concave beyond, length 0.625 (0.58) mm., depth 0.152 (0.135) mm.; tarsus cylindrical, both margins nearly straight, tarsal claws simple, a tactile seta inserted on the extensor surface 0.33 (0.33) mm. from the proximal margin; tarsus 0.43 (0.43) mm. long, 0.095 (0.097) mm. deep.

Genitalia highly sclerotic; a few scattered setae on the posterior operculum with a group of three stout and peculiarly toothed setae along the rim of the operculum on one side and a group of four on the other side in the holotype, two on one side and three on the other side in the paratype; these grouped setae (fig. 4) of the posterior operculum are distinctly bent near the midpoint where there is inserted a sharp accessory tooth; anterior operculum with a large number of somewhat slender setae, those located near the genital aperture frequently toothed like the setae of the posterior operculum; sclerotic rod of the statumen convolutum appears to be attached at its inner end to the inner end of the margin of the statumen convolutum, rod not reaching beyond the anterior end of the statumen convolutum.

FEMALE: Description based on the allotype only. General body structure as in the male; female 3.7 mm. in length. Carapace as in the male except no keel is present on the posterolateral corner; posterior carapacial margin with 10 setae; carapace 0.98 mm. long, 0.86 mm. wide across the posterior margin, ocular breadth 0.49 mm. Abdomen essentially like that of the male, except the tergal keels are absent and the sternites are much lighter in color; abdomen 2.7 mm. long, 1.4 mm. in width. Chelicera as in the male; rami of galea possibly a little more conspicuous and larger; length of chelicera 0.255 mm., width of base 0.148 mm., length of movable finger 0.19 mm. Palpus from the dorsad as in the male, except that the femur and chela (fig. 5) appear a little stouter; maxilla 0.48 mm. long, 0.30 mm. wide; trochanter 0.52 mm. in length, 0.27 mm. in width; femur 1.05 mm. long, 0.25 mm. wide; tibia 0.90 mm. long, 0.30 mm. wide; chela 1.50 mm. long, 0.43 mm. wide. Chela from the side with marginal teeth and tactile setae distinctly as in the male; length of hand without pedicle 0.84 mm., depth of hand 0.37 mm.; length of movable finger 0.71 mm. Legs of female essentially as in the male, except for the tibia and tarsus of the first leg. First leg with trochanter 0.21 mm. long, 0.152 mm. deep; pars basalis 0.32 mm. long, 0.182 mm. deep; pars tibialis 0.415 mm.

long, 0.167 mm. deep; tibia much more slender than in the male, extensor margin weakly S-shaped, flexor margin evenly convex except at the very base, length of tibia 0.415 mm., depth 0.125 mm.; tarsus subcylindrical, flexor margin virtually straight, extensor margin a little convex, length 0.38 mm., depth 0.098 mm.; tarsal claws without accessory teeth, fairly stout, well curved. Fourth leg virtually as in the male; trochanter 0.34 mm. long, 0.185 mm. deep; pars basalis 0.28 mm. in length, 0.17 mm. in depth; pars tibialis 0.69 mm. in length, 0.27 mm. in depth; entire femur 0.835 mm. long; tibia 0.625 mm. long, 0.145 mm. deep; tarsus with extensor margin a little convex, 0.44 mm. long, 0.105 mm. deep; tactile seta of tarsus removed by 0.355 mm. from the proximal margin; tarsal claws simple. With respect to the genitalia, the middle cribriform plates are subequal in size to the lateral plates; posterior operculum with 14 marginal setae arranged in a single row; anterior operculum with 20 or more hair-like setae along the posterior margin.

TYPE LOCALITY: The male holotype, the female allotype, and one male paratype from Flagstaff, Arizona; April 30, 1936; "lot 36-12." The type specimens are deposited in the American Museum of Natural History.

REMARKS: Although several other species are known in the genus *Hysterochelifer* in the Palearctic region, only two other species are known from North America. From the forms described in the Old World, our species can be separated by the size and the length:width ratios of the palpal podomeres. One European form, *Hysterochelifer gracilimanus* Beier, 1949, apparently should not be assigned to this genus. Its affinities are somewhat doubtful, but it is probably representative of a new genus. One of the North American species is *H. fuscipes* (Banks, 1909) from California. Our form differs from *fuscipes* by having a more slender chela, with the fingers conspicuously shorter than the hand, and by having a much larger body size. The other North American species is *H. geronimoensis* (Chamberlin, 1923) from Lower California. In our species again, the body is larger and the palpal podomeres, especially the chela, are much more slender than in *geronimoensis*.

PAISOCHELIFER HOFF, 1946, EMENDED

Paisochelifer Hoff, 1946, Bull. Chicago Acad. Sci., vol. 7, p. 487.

DIAGNOSIS EMENDED: Carapace wider than long, almost uni-

formly granular; transverse furrows deeply impressed, the posterior furrow about one-half as far from the posterior carapacial margin as from the median furrow; one pair of eyes. Tergites, including the eleventh, divided; lateral keels of the male wanting or very weakly developed. Cheliceral hand with tactile seta SB either present or absent; in rare instances a supernumerary seta is inserted between B and SB. Flagellar setae of chelicera smooth, not serrate. Setae of movable chelal finger somewhat variable; fixed finger of chela with tactile setae *est* and *ist* proximal to the midpoint of the finger. Coxa of the fourth leg of the male with coxal sac; spur of coxa IV of the male lacking; subterminal setae of the fourth tarsus toothed; tarsus of the first leg of the male without a terminal spine; claws of pedal tarsi, except the first leg of the male, simple; a tactile seta located distal to the midpoint of the fourth pedal tarsus. Statumen convolutum incised anteriorly and containing a sclerotic rod.

GENOTYPE: *Hysterochelifer callus* Hoff, 1945.

REMARKS: The present emendation is made necessary by the inclusion in the genus of a new species, *P. utahensis*, and by the detection of considerable variability in the setae of the cheliceral hand of both *P. callus* and *P. utahensis*.

***Paisochelifer callus* (Hoff, 1945)**

Hysterochelifer callus HOFF, 1945, Amer. Midland Nat., vol. 34, pp. 515-521.

Paisochelifer callus HOFF, 1946, Bull. Chicago Acad. Sci., vol. 7, p. 487; 1949, Bull. Illinois Nat. Hist. Surv., vol. 24, pp. 489-491.

RECORD: One male and one tritonymph from sifting in pine woods, 5 miles east of Salisbury, Maryland, on April 7, 1945. The specimens were submitted for determination by Prof. Martin H. Muma and have been placed in the collections of the American Museum of Natural History.

REMARKS: The present male agrees well with specimens from Illinois, except that the chela is a little stouter while the other palpal podomeres are on the average a trifle more slender in the male from New Jersey. It is possible that a large series of specimens from both New Jersey and Illinois, the type locality, might allow the establishment of a subspecific ranking for the New Jersey specimens, but this is doubtful. The present male is very peculiar since the tactile seta SB is absent from the cheliceral hand. At first it was thought that this would require the establishment of a new genus or subgenus, but since the discovery of

the variability of this seta in *P. utahensis*, as mentioned below, and since the tritonymph of *P. callus* examined had the tactile seta SB missing from one chelicera but present in the other, it is obvious that this seta shows considerable variability. Moreover, a specimen of *P. callus* examined from Illinois shows an extra seta inserted between SB and B on the one chelicera and not on the other. Such variation precludes the use of the tactile setae of the cheliceral hand as criteria upon which to base groupings of either the generic or specific rank.

The male from New Jersey has a body length of 1.85 mm., while the palpal podomeres measure as follows: trochanter 0.30 mm. long, 0.18 mm. wide; femur 0.64 mm. long, 0.175 mm. wide; tibia 0.55 mm. long, 0.21 mm. wide; chela 0.99 mm. long, 0.32 mm. wide; length of hand 0.50 mm., depth of hand 0.27 mm.; movable finger 0.52 mm. in length.

The tritonymph examined has a body length of 1.55 mm. The palpal trochanter is 0.245 mm. long, 0.15 mm. wide; femur 0.46 mm. long, 0.145 mm. wide; tibia 0.38 mm. long, 0.17 mm. wide; chela 0.76 mm. long, 0.245 mm. wide; chelal hand 0.39 mm. long, 0.22 mm. deep; movable finger 0.39 mm. long.

***Paisochelifer utahensis*, new species**

Figures 6-9

MALE: Description based on the holotype. Body stout, appendages moderately slender; cephalothorax and palpi golden brown in color, abdomen and legs lighter brown in color; body nearly 3.0 mm. long. Carapace conforming well to the characteristics given for the genus; anterior margin broadly rounded; setae sparse and seldom located on elevated tubercles, short and terminally denticulate, not clavate; six setae along the carapacial margin between the eyes, posterior margin with 10 setae; surface of carapace very conspicuously granulate; carapace 0.85 mm. long, 0.90 mm. wide across the posterior margin; ocular width 0.42 mm. Abdomen ovate in general outline; lateral margins evenly convex; tergites, including the eleventh, divided, conspicuously granulate; virtually no indication of tergal keels; setae of the tergites like those of the carapace, a single marginal row in each tergite with one seta at the lateral margin of each tergal half; most tergal halves with either five or six setae; sternites, including the eleventh, divided, surface of anteriormost

sternal halves marked by net-like lines, becoming granulate like the tergites in the posterior sternal halves; fourth sternite with five or seven setae on each half, usually six or seven marginal setae on each sternal half of rest of abdomen; anterior stigmatic plate without setae, each posterior plate with a single seta; pleural membranes roughly striated; abdomen 2.05 mm. long, 1.13 mm. in greatest width.

Chelicera yellowish brown in color; fairly stout except the fixed finger slender; fixed finger with three denticles on the inner margin of the apical tooth and three well-spaced and strongly developed retroconical denticles on the inner finger margin; movable finger gently curved and with a blunt denticle near the level of the insertion of the galeal seta; apical tooth terminally roughened; galea stout and with five or more short and curved rami confined to the distal one-half; apparently about 16 plates in the serrula exterior but condition of specimen precludes an exact count. Base of chelicera stout, setae as in the genus with IS and LS long and reaching to the end of the fixed finger, acuminate; in one chelicera, seta SB with one or two fine subterminal denticulations; SB wanting from the other chelicera; B with a weak subterminal denticulation; ES acuminate and with a length equal to about two-thirds of the length of IS. Flagellum with setae slender and apparently entire, the middle seta almost as long as the distal seta and the basal seta about two-thirds as long as the distal one; hand with a few net-like markings; chelicera 0.235 mm. long, width of hand not secured; movable finger with length of 0.17 mm.

Palpus (fig. 6) moderately slender; golden in color; surface, except for the chelal fingers, heavily and conspicuously granulate; setae fairly numerous, short, and terminally and subterminally paucidenticulate, except on the fingers where the investing setae are longer and acuminate. Maxilla 0.39 mm. long, 0.27 mm. wide. Trochanter with a pedicle a little wider than long, a conspicuous and well-rounded dorsal protuberance present, flexor and extensor margins evenly rounded, length 0.445 mm., width 0.23 mm. Femur with a poorly separated pedicle, flexor margin weakly concave, extensor margin almost straight in the center portion but a little convex near the distal end, length 0.965 mm., width 0.21 mm. Tibia with pedicle about as long as wide, well separated from the rest of the podomere along the flexor margin, flexor margin of tibia very weakly convex to almost straight, extensor margin

flatly convex in the center, more convex near each end, tibia widest in the distal one-fourth, length 0.78 mm. long, 0.235 mm. wide. Chela from the dorsad with moderately stout hand, pedicle a very little wider than long and located near the center of the hand; extensor margin of hand evenly and weakly convex; flexor margin less evenly convex than the extensor margin; the hand is somewhat abruptly narrowed just proximad to the base of the fingers; fingers fairly slender and gently curved; chela without pedicle 1.40 mm. long, 0.365 mm. wide; movable finger 0.75 mm. in length. From the side, the hand (fig. 7) appears more slender than in dorsal view; pedicle deeper than long and located near the center of the symmetrically rounded basal margin; ventral margin of hand weakly but evenly convex, the dorsal margin more convex, especially near the center; hand deepest near the center; fingers little curved, inner margin of fixed fingers slightly convex, of movable finger slightly concave; hand 0.72 mm. long, 0.31 mm. deep. Tactile setae of the chelal fingers as shown in the figure. Marginal teeth of fixed chelal finger strongly formed and with well-developed retroconical cusps in the distal half of the finger, teeth becoming in the basal half of the finger acuspid and reduced, to disappear eventually from the basal portion of the finger; the marginal teeth of the movable finger like those of the fixed finger, except that all teeth, with exception of the very distal one, have cusps and the teeth extend almost to the base of the finger, not being gradually reduced proximally as in the fixed finger; a total of 41 teeth on the fixed finger, 47 teeth on the movable finger.

Legs almost yellow in color, sometimes a little golden tinge evident; podomeres granulate on surface, the distal ones becoming almost smooth; setae on the extensor margin of podomeres chiefly short and paucidentate, those of the flexor margin longer and acuminate; claws entire except on the first leg of the male. First leg with trochanter 0.185 mm. long, 0.14 mm. deep; pars basalis club-shaped, 0.28 mm. long, 0.15 mm. deep; pars tibialis subspindle-shaped, both margins evenly convex, deepest near the center, 0.39 mm. long, 0.13 mm. deep; tibia with extensor margin nearly straight except near the proximal end, flexor margin gently convex, deepest at about the distal one-third, 0.37 mm. long, 0.112 mm. deep; tarsus (fig. 8) fusiform, both margins weakly convex, deepest near the center, 0.33 mm. long, 0.095 mm. deep; one tarsal claw of the usual shape, the other

more bent near the center and with a slender and acute accessory tooth located about one-third of the length of the claw from the tip. Fourth leg with trochanter 0.31 mm. long, 0.145 mm. deep; pars basalis subtriangular, 0.21 mm. long, 0.15 mm. deep; pars tibialis with straight flexor margin, extensor margin convex, more convex basally than distally, length 0.57 mm., depth 0.20 mm.; entire femur 0.69 mm. long; tibia very weakly S-shaped, length 0.51 mm., depth 0.115 mm.; tarsus subcylindrical, 0.43 mm. long, 0.085 mm. deep; a tactile seta located on the extensor surface of the tarsus 0.34 mm. from the proximal margin.

Genitalia: statumen convolutum incised anteriorly to contain a sclerotic rod that does not extend anteriorly beyond the incision; anterior operculum very setaceous, being well covered by setae; posterior operculum with few setae, the most conspicuous being a transverse row of five compactly grouped setae on the edge of the operculum to each side of the median line.

FEMALE: Description based on the allotype. Essentially like the male but body, especially the abdomen, lighter in color; body and appendages a little larger; each of the tergal halves usually with six or seven setae; sternite 4 with 10 setae; body 3.15 mm. long; carapace 0.88 mm. long, 0.93 mm. wide across the posterior margin; ocular breadth of the carapace 0.45 mm.; abdomen 2.25 mm. long, 1.5 mm. wide. Chelicera as in the male; number of plates in the serrula exterior estimated as 19 but position precludes an accurate count; tactile seta SB present on both chelicerae; chelicera 0.25 mm. long, 0.156 mm. wide across the base; movable finger 0.20 mm. long. Palpus essentially as in the male, except podomeres slightly larger; both flexor and extensor margins of chela (fig. 9) appear more convex, and the hand is less abruptly narrowed near the base of the finger than in the male; also the extensor and basal margins join in more of a pronounced angle than in the male; side view of chela not obtained since allotype has one chela missing; maxilla 0.45 mm. long, 0.29 mm. wide; trochanter 0.46 mm. long, 0.26 mm. wide; femur 1.06 mm. long, 0.225 mm. wide; tibia 0.85 mm. long, 0.26 mm. wide; chela 1.53 mm. in length, 0.40 mm. in width; length of hand 0.78 mm., length of movable finger 0.80 mm. Tactile setae of the female essentially as in the male. Movable chelal finger with 51 teeth; as near as can be determined, fixed finger with 49 teeth; teeth apparently as in the male. The legs of the female much like those of the male with exception of a slightly larger

size and the difference in shape of the tibia and tarsus of the first leg. First leg of female with trochanter 0.21 mm. long, 0.15 mm. deep; pars basalis 0.305 mm. long, 0.157 mm. deep; pars tibialis 0.42 mm. long, 0.135 mm. deep; tibia a little S-shaped, with the extensor margin somewhat concave, 0.38 mm. long, 0.10 mm. deep; tarsus subcylindrical, more slender than in the male and less deepened near the distal end, margins nearly straight, claws simple, length 0.39 mm., depth 0.081 mm. Fourth leg as in the male; trochanter 0.36 mm. long, 0.178 mm. deep; pars basalis 0.26 mm. long, 0.173 mm. deep; pars tibialis 0.64 mm. long, 0.22 mm. deep; entire femur 0.785 mm. long; tibia 0.55 mm. long, 0.125 mm. deep; tarsus 0.47 mm. long, 0.095 mm. deep; tactile seta inserted on extensor margin 0.37 mm. from the proximal margin of the tarsus. Genitalia of female with the cribriform plates of the median pair about as large in size as the lateral ones; anterior operculum with four setae on the face of the operculum and a few, chiefly broken from the allotype, along the posterior margin of the operculum; posterior operculum with a single row of 10 well-spaced setae.

TYPE LOCALITY: A single male, the holotype, and a single female, the allotype, taken from Utah Lake, Utah, on August 18, 1931. The types are deposited in the American Museum of Natural History.

REMARKS: The only other species known in the genus *Paisochelifer* is the genotype, *P. callus* (Hoff, 1945). The new species differs from the genotype in many ways, including the much larger size of the body and appendages and the definitely more slender palpi.

***Levichelifer fulvopalpus* (Hoff, 1946)**

Idiochelifer fulvopalpus HOFF, 1946, Amer. Mus. Novitates, no. 1318, p. 23

Levichelifer fulvopalpus HOFF, 1946, Bull. Chicago Acad. Sci., vol. 7, p. 487.

LOCALITY RECORDS: The American Museum collections contain large numbers of this species from Texas: La Joya by L. I. Davis, October 30, 1938; Cameron County by Davis, January to March, 1936; Blackwell, collected by "F. C. B." August 15, 1926; Edinburg, collection taken by "D. M.," April 23, 1938; Rio Grande City, by S. Mulaik, April 29, 1939; Llano County, collected by Davis, July 10-12, 1936; Edinburg, by S. Mulaik, February 5, 1939; Canadian River, 19 miles north of Amarillo, taken by L. I. Davis, July 15, 1939; 10 miles north of Alice, col-

lection made by Mulaik, June 7, 1937; Edinburg, collected by S. Mulaik, December 7, 1935; and great numbers of individuals taken from the nests of pack rats (*Neotoma micropus* Baird) at Laguna Madre, 25 miles southeast of Harlingen, three collections made by D. E. Hardy and one by D. E. Hardy and V. L. Woolley, during May, August, and September, 1945. The Illinois State Natural History Survey collections contain one collection taken in Denton County, Texas, from leaf mold on sandy soil by B. Maxwell, December 28, 1946, and a second collection containing what is tentatively identified as a female of this species and marked simply "Palacios, Mexico; 5-5-38." A collection (AP No. 25517) containing a single male submitted for determination by the Hamilton, Montana, Rocky Mountain Laboratory of the United States Public Health Service was taken by C. B. Philip from a wood rat (*Neotoma* sp.) nest at Silver City, New Mexico, 1938.

REMARKS: The examination of a large series of specimens from Texas indicates that there is considerably more variation in this species than is indicated by the type lot from Reynosa, Tamaulipas, Mexico, a locality just across the international boundary from Texas. The variation to be expected in the males of this species is shown by the following ranges of measurements of palpal podomeres secured by combining the measurements of the original lot of five type specimens from Mexico with 10 additional individuals from Texas. The ranges are as follows: palpal femur 0.79–0.93 mm. long, 0.17–0.20 mm. wide, length 4.4 to 5.0 times the width; palpal tibia 0.72–0.83 mm. long, 0.195–0.245 mm. wide, length 3.3 to 3.8 times the width; chela 1.20–1.38 mm. in length, 0.28–0.36 mm. in width, length 3.7 to 4.4 times the width; depth of chelal hand 0.255–0.32 mm.; length of chelal hand 0.57–0.67 mm.; length of movable chelal finger 0.67–0.75 mm. While the actual sizes of the palpal podomeres of the female are larger than in the male, the same relative amount of variation is obvious. Besides variation in size of the palpal podomeres, other structures of the male are also somewhat variable. For instance, it is often difficult to see the sclerotic rod in the statumen convolutum because of its small size and somewhat hidden position, and, in other instances, the accessory tooth appears to be much reduced and even absent from the posterior claw of the first leg of the male.

The single individual male from New Mexico has the palpal

podomeres slightly more slender than in the majority of specimens from Texas, but this individual is certainly conspecific with the material from Texas and Mexico. Palpal podomeres of the male from New Mexico measure as follows: femur 0.86 mm. long, 0.17 mm. wide; tibia 0.74 mm. long, 0.20 mm. wide; chela 1.21 mm. in length, 0.27 mm. in width; chelal hand with depth of 0.25 mm., length of 0.57 mm.; movable finger 0.70 mm. in length.

Among the collections of the American Museum of Natural History were found a single female and one deutonymph of what appears to be a new species of *Levichelifer* collected by A. F. Archer, on January 17, 1941, from Jackson Oak, Baldwin County, Alabama. Since no males are present and it is impossible to make a certain generic assignment, I believe it advisable not to describe this form as new at the present time. If this form is, as it appears to be, congeneric with *fulvopalpus*, then it is certainly new to the literature.

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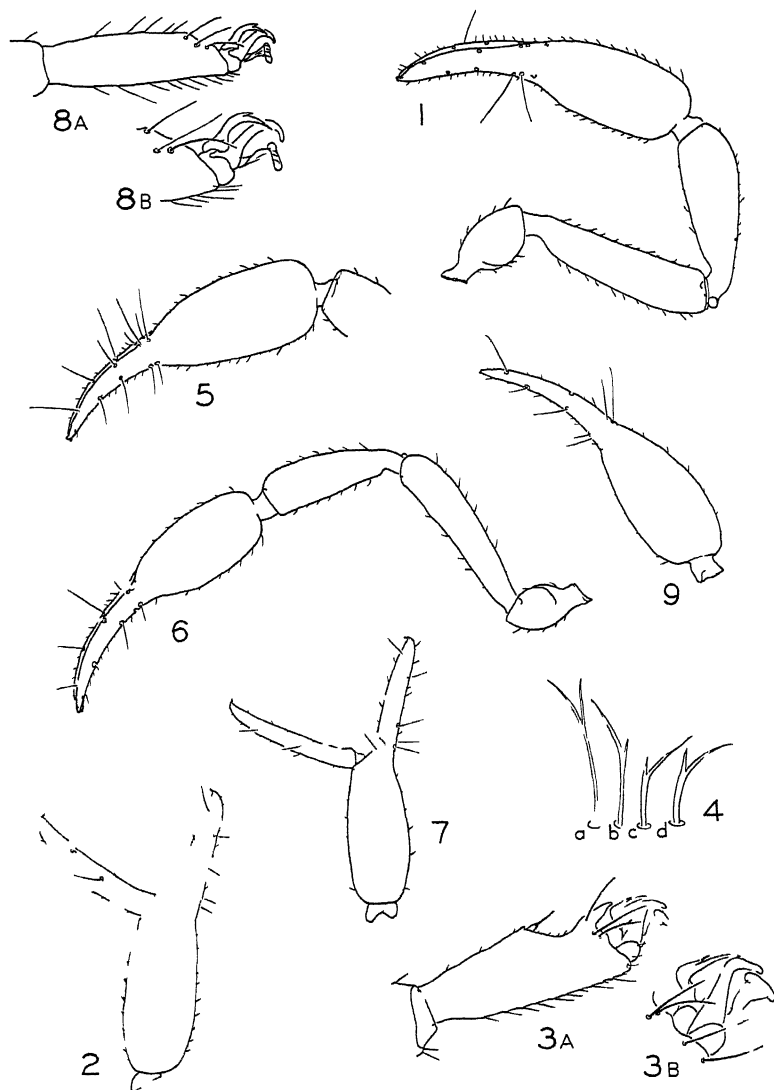
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FIGS 1-5 *Hysterochelifer piopiuius* new species 1 Dorsal view of palp, male holotype 2 Lateral view of chela male holotype 3A Tarsus of first leg, male holotype 3B Terminal claws of tarsus of first leg, male holotype 4 Setae of genital opercula, male holotype *a* and *b* from anterior operculum, *c* and *d* from posterior operculum 5 Dorsal view of palpal chela female allotype

FIGS 6-9 *Paisochelifer utahensis*, new species 6 Dorsal view of palp, male holotype 7 Lateral view of chela male holotype 8A Tarsus of first leg, male holotype 8B Terminal claws of tarsus of first leg male holotype 9 Dorsal view of palpal chela, movable finger wanting, female allotype

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STUDIES OF PERUVIAN BIRDS. NO. 55 THE HUMMINGBIRD GENERA *DORYFERA*, *GLAUCIS*, *THRENETES*, AND *PHAETHORNIS*

BY JOHN T. ZIMMER

I am greatly indebted to Mr. Rodolphe M. deSchauensee of the Academy of Natural Sciences of Philadelphia, Dr. Herbert Friedmann of the United States National Museum, Washington, D.C., Dr. Karl P. Schmidt and Mr. Emmet R. Blake of the Chicago Natural History Museum, and Dr. William H. Phelps of Caracas, Venezuela, for the generous loan of critical material used in the following studies, and to Captain Jean Delacour for making certain important comparisons of material in the British Museum, to the authorities of which institution I am likewise grateful for the courtesies involved.

Names of colors are capitalized when direct comparison has been made with Ridgway's "Color standards and color nomenclature."

Doryfera johannae johannae (Bourcier)

Troch[ilus] Johanna BOURCIER, 1847, Proc. Zool. Soc. London, pt. 15, p. 45—"Le Pérou"; ♂; British Mus.

Trochilus (Doryfera) violifrons GOULD, 1847, Proc. Zool. Soc. London, pt. 15, p. 95—no locality, probably Bogotá; British Mus.

Doryfera Euphrosinae MULSANT AND VERREAUX, 1872, Ann. Soc. Linnéenne Lyon, new ser., vol. 18, p. 319—"L'Equateur."

I have no Peruvian specimens of this species of which there are records from Huambo and above Chayavitas. Neither locality can well be suggested as restricted type locality since I can find no evidence that Edward Matthews, who collected the type, ever

visited either place. He traveled down the Huallaga River to the mouth of the Río Mayo and turned inland through Tarapoto to Moyobamba. The occurrence of the bird at Huambo and in the mountains near Chayavitas suggests the possibility that it occurs also at Chachapoyas which Matthews also visited. The restriction of type locality to Chachapoyas is therefore tentatively suggested.

A specimen in the American Museum collection is marked "Type" but is hardly likely to be entitled to that rank. It has no original label and the existing tag bears the name "*Doryfera Johannaë*" whereas Bourcier described it as "*Trochilus*," and the locality is marked as "New Grenada" instead of "Le Pérou" actually specified by Bourcier. Boucard (1895, Genera of humming birds, p. 308) said that the type was then still in the Loddiges Collection (now in the British Museum), although he ascribes it to Colombia. The bird at hand is from the Elliot Collection, but Elliot in his monograph makes no mention of possession of the type as he did in certain other cases. He may have obtained the bird from Bourcier, as indicated on the label, but I judge it to be no more than a representative specimen, not the type.

Ecuadorian specimens have the bill a little longer on average than the Colombian birds (25.5–29.5 mm., as against 24–29), but the overlap is too great to indicate any subspecific distinction as has been proposed for *Doryfera ludovicae* in the same areas, discussed below under *ludovicae*. The Guianan-Venezuelan *D. j. guianensis* has a more consistently shorter bill and in addition differs by lighter ventral coloration of the males and less deeply violaceous frontal patch.

SPECIMENS EXAMINED

D. j. johannaë.—

COLOMBIA:

"Bogotá," 13 [♂], 2 [♀].

ECUADOR:

Below San José, 6 ♂, 5 ♀;

"Ecuador," 1 [♀].

D. j. guianensis.—

BRITISH GUIANA:

Merumé Mts., 1 ♂.

VENEZUELA:

Mt. Duida (750–5000 ft.), 5 ♂, 6 ♀;

Mt. Auyan-tepui, 1 ♂, 1 (?);

Mt. Roraima, Arabupú, 1 ♀.

Doryfera ludovicae ludovicae (Bourcier and Mulsant)

Trochilus ludovicae BOURCIER AND MULSANT, 1847, Ann. Soc. d'Agric., Sci., Indus. Lyon, vol. 10, p. 136—Nouvelle-Grenade; Buena Vista, above Villavicencio, Colombia, suggested by Chapman, 1917.

Doryfera rectirostris GOULD, 1861, An introduction to the Trochilidae, p. 71—Ecuador, ♂♂, ♀ cotypes in British Mus.

Doryfera ludovicae grisea CARRIKER, 1935 (Oct. 10), Proc. Acad. Nat. Sci. Philadelphia, vol. 87, p. 317—Calabatea, Río Coroico, Dept. La Paz, Bolivia; ♀; Acad. Nat. Sci. Philadelphia.

Chapman (1926, Bull. Amer. Mus. Nat. Hist., vol. 55, p. 282) has already called attention to the great variation in measurements shown by the present species from Venezuela and Colombia to southeastern Perú, and suggests the possibility that *rectirostris* might prove to be inseparable from *ludovicae*. With 21 additional specimens from Venezuela and Colombia (the latter, however, "Bogotá-skins" of uncertain sex), I find an overlap even greater than that pointed out by Chapman. The exposed culmen of the Colombian and Venezuelan birds ranges from a minimum of 29 mm. in the females to a maximum of 34 in the males; Ecuadorian and north-Peruvian birds: 32–36.5, southeast-Peruvian: 29–33.5. In the zone of overlap are 12 of 26 Colombian and Venezuelan birds, 19 of 24 Ecuadorian and north-Peruvian, and five of seven southeast-Peruvian specimens. The averages are slightly different: 31.6 for Colombia and Venezuela; 34 for Ecuador and northern Perú; and 32.0 for southeastern Perú—but the number of specimens unidentifiable by their measurements is so predominant that the criterion appears to be of no practical value.

It is admitted that the lumping together of the measurements of both sexes is open to some valid objections, but it is not certain that there is a positive difference in the bill lengths of males and females. Certainly in the series of sexed birds available the longest-billed bird is a female, as is the shortest-billed one, and in the series from eastern Ecuador and northern Perú, the average of the females is a fraction of a millimeter more than that of the males. In order to utilize the series of non-sexed "Bogotá-skins" and others, therefore, the complete range of measurements has been recorded without regard to sex.

There appears to have been some confusion also in regard to the sexual distinction in color. Hartert (1900, Das Tierreich, no. 9, p. 11), noted no distinctions. Simon (1921, Histoire naturelle des Trochilidae, p. 2) credited the females with an ab-

sence of the frontal patch. Neither statement is wholly correct. Some females lack all trace of the frontal patch (including one bird found on the nest and therefore certainly adult); others appear to have the patch as fully developed as the males; still others have the patch present but reduced in area, perhaps restricted to a few individual glittering feathers. The general coloration of the females may sometimes be slightly duller than that of the males, but in many examples there is no perceptible difference.

The Peruvian birds at hand have the upper tail-coverts a little less pronouncedly blue than the average example from farther north, but the Peruvian series is limited and numerous extremes from Ecuador, Colombia, and Venezuela are no different. Even if the character were found to be constant in a larger series from Perú, its value would still be questionable because of the number of northern examples possessing it. The same condition exists in *Doryfera johannae*.

Bond and deSchauensee (1943, Proc. Acad. Nat. Sci. Philadelphia, vol. 95, p. 200) found the type of "*grisea*" to be a young male indistinguishable from Ecuadorian specimens.

With these evidences of variation and overlap of characters, it seems best to join *ludovicae*, *rectirostris*, and *grisea* into a single subspecies while recognizing the fact that it reaches a peak of bill length in the heart of the range, in Ecuador. The Central American form, *veraguensis*, is quite distinctly darker and readily recognizable.

Additional Peruvian records of *rectirostris* are from Huambo, Río Jelashte, Chirimoto, Ray-urmana, Garita del Sol, Huaynapata, and Río Cadena.

SPECIMENS EXAMINED

D. l. veraguensis.—

COSTA RICA:

(La Estrella, Guayabo, La Hondura, La Palma, Irazú, and "Costa Rica"),
5 ♂, 2 ♀.

PANAMÁ:

(Veragua and Chiriquí), 3 ♂, 1 (?).

D. l. ludovicae.—

VENEZUELA:

(Mérida, Nevados, El Hechisera, and Montañas Sierra), 7 ♂, 1 ♀, 5 (?).

COLOMBIA:

(Buena Vista, Salento, Miraflores, Medellín, and "Bogotá"), 1 ♂, 3 ♀,
15 (?).

ECUADOR:

(Oyacachi, lower Sumaco, below San José, Río Zamora or Río Pastaza, and "Quito"), 20 ♂, 14 ♀, 5 (?).

PERÚ:

La Lejia, 1 ♂, 1 ♀;

Santo Domingo, 1 ♂, 2 ♀, 1 (?);

Inca Mine, 2 ♀.

***Glaucis hirsuta affinis* Lawrence**

Glaucis affinis LAWRENCE, 1858, Ann. Lyc. Nat. Hist. New York, vol. 6, p. 261—Ecuador; type from Río Napo, Amer. Mus. Nat. Hist.

Glaucis hirsuta fusca CORY, 1913, Field Mus. Nat. Hist., ornith. ser., vol. 1, p. 286—Orope, Zulia, Venezuela, ♂, Chicago Nat. Hist. Mus.

The arrangement of the present species is extremely unsatisfactory owing in part to the great individual variation exhibited throughout the range and in part to the fact that perfectly adult specimens are in the minority in the otherwise extensive series available for study. Young birds, recognizable by their more acute rectrices and buffy terminal margins of the dorsal feathering, white terminal spots on the remiges, and often by buffy, cinnamonaceous, or grayish tips on some of the pectoral and gular plumes, show much variation in these particulars that may be variously combined or individually lacking, and it appears likely that various ages are represented, but the fact remains that when any or all of these characteristics are present, subspecific distinction is rendered even more difficult than it is in the adults.

When only the male birds that appear to be fully adult are compared, it appears that male *affinis* is characterized by relatively dark and dull rufescent coloration of the throat and chest, and a grayish drab tone of the belly, occasionally washed with the color of the chest. Such material as I have from the eastern tier of Brazilian states indicates that *hirsuta hirsuta* (*Trochilus hirsutus* Gmelin, 1788, Systema naturae, vol. 1, pt. 1, p. 490—Brazil; I suggest Bahia as restricted type locality) is a little lighter and brighter on the breast and paler and more ochraceous or light rufescent on the belly. Taking these two standards for comparative purposes, I find that specimens from as far east as the Rio Madeira (both banks), south of the Amazon, are distinctly closer to *affinis* than to *hirsuta*, and even examples from the Rio Xingú are intermediate. Likewise specimens from the foot of Mt. Duida in Venezuela, although all show varying degrees of

immaturity, are certainly referable to *affinis*, although specimens from the lower Rio Negro are again intermediate. It may be noted that the type of *affinis* is not the darkest of the Ecuadorian birds at hand but still has enough of the grayish abdominal tone to assure its identification with the subspecies with which it has always been associated. At least one Rio Madeira bird, from Humaythá, is near the darkest extreme of the subspecies. The outside limit is shown by a male from below San José, Ecuador.

Females are less easily determinable than the males and although those of *affinis* average darker and duller below than those of *hirsuta*, the reverse is sometimes apparent.

I am not sure that Guianan and perhaps northeastern-Venezuelan birds are referable to *hirsuta hirsuta* and not to a separable form (for which names are available), but would need to see a good series of adult males from southeastern Brazil before assuring myself of the correctness of that idea. The northern birds appear to be brighter in coloration than the others. Birds from Bolivia and Matto Grosso likewise are uncertain in view of the limited material at hand.

I have been unable to discover any positive dimensional criteria in the species except in the case of the short-winged, short-tailed *aenea* of the Pacific coastal region. The Trinidad-Tobago-Grenada form, *insularum*, has the maximum average measurements of all of the recognized forms, but they are only average and one male *hirsuta* from the Paria Peninsula of Venezuela has a slightly longer tail than any example of *insularum* at hand. In this connection it may be of interest to call attention to two unusual specimens without accurate data that exceed the present series of *insularum* in both wing and tail measurement. One is labeled "Peru" and the other "Brazil" but both are dealer's skins from H. Whitely. Also, both are partially albinistic, although both have the under parts (anteriorly, only, in the "Brazil" specimen) relatively dark cinnamonaceous as in many *insularis*. The bird from "Peru" has the wing 74 mm.; the tail, 46; the "Brazil" specimen: 71 and 45.5, respectively. The males of *insularum* at hand show 70 and 43, respectively, although Hellmayr and Seilern, in the original description of *insularum*, report maxima of 70 and 46. I believe, therefore, that these two birds are actually *insularum* with incorrect localities, supplied by the dealer.

Additional records of *affinis* from Perú are from Río Javari,

Pebas, "Peruvian Amazons," "Upper Ucayali," Yurimaguas, Santa Cruz, Moyobamba, and Chamicuros.

SPECIMENS EXAMINED

G. h. hirsuta.—

BRAZIL:

Bahia, Cajazeiras, 1 ♂, 1 (?);
 "Bahia," 4 (?);
 "Brasilia," 1 ♂, 1 ♀, 1 (?) (cotypes of "*ferrugineus*");
 Matto Grosso, Chapada, 1 ♂;
 Descalvados, 1 ♀;
 "Pará," 1 (?);
 Pará, Prata, 1 ♂, 1 (?);
 Rio Xingú, Tapará, 1 ♂, 1 (?);
 Porto de Moz, 3 ♂, 1 (?);
 Villarinho do Monte, 1 ♂;
 Villa Bella Imperatriz, 1 ♂, 1 ♀;
 Rio Negro, Igarapé Cacao Pereira, 2 ♂, 1 ♀;
 Rio Negro, 1 (?);
 "Brazil," 4 (?).

BOLIVIA:

Mission San Antonio, 1 ♂, 2 ♀;
 Todos Santos, 1 ♂.

CAYENNE:

(Roche Marie, Approuague, and "Cayenne"), 6 ♂, 2 ♀, 2 (?).

SURINAM:

(Near Paramaribo, Javaweg, Kwata, and "Interior"), 6 ♀, 3 (?).

"GULANA": 1 (?).

VENEZUELA:

(Las Trincheras, Cumanacoa, Cristóbal Colón, Las Quiguas, San Antonio, San Estéban, El Limón, Temblador, Munduapo, La Prisión, "Orinoco," Roraima, and "Venezuela"), 9 ♂, 7 ♀, 3 (?).

G. h. insularum. -

TRINIDAD:

(Princetown, Carenage, Cuparo, Laventille, Forres Park, and "Trinidad"), 13 ♂, 5 ♀.

TOBAGO:

(Castare, Richmond, Englishman Bay, and "Tobago"), 5 ♂, 5 ♀, 1 (?).

GRENADA: 1 ♀.

? "PERU" AND "BRAZIL" (loc. err.), 2 (?).

G. h. affinis. -

PERÚ:

Lagarto, Río Ucayali, 2 ♂, 3 ♀;
 Santa Rosa, 1 ♂;
 Pachiza, 1 ♀;
 mouth of Río Cahuapanas, 1 ♂;
 mouth of Río Cenipá, 1 ♂;
 Iquitos, 1 ♂;

Jeberos, 1 (?);
 mouth of Río Curaray, 4 ♂, 2 ♀;
 Apayacu, 1 ♀;
 "Perú," 1 ♂.

ECUADOR:

Below San José, 1 ♂;
 Napo River, 1 (?) (type).

COLOMBIA:

La Morelia, 1 ♂, 1 ♀;
 Villavicencio, 1 ♂;
 Alto Bonito, 2 ♂;
 Malena, 1 ♂;
 Cunday, 1 [♂];
 Cali, 1 "♂" [= ♀], 1 ♀;
 "Bogotá," 3 [♂], 3 [♀];
 Santa Marta, Don Diego, 1 ♂.

VENEZUELA:

Mérida, 1 (?);
 Mt. Duida, Playa del Río Base, 1 ♂;
 Río Orinoco, LaLaja, 2 (?).

BRAZIL:

Teflé, 1 ♀;
 Rio Madeira, Rosarinho, 1 ♂;
 Borba, 1 ♂;
 Marmellos, 4 ♂, 2 ♀;
 Calamá, 1 ♂, 1 (?);
 Humaythá, 3 ♂, 1 ♀;
 Igarapé Auará, 2 ♂;
 Rio Preto, Santa Isabel, 2 ♂, 1 ♀.

PANAMÁ:

El Real, Río Tuyra, 2 ♂, 2 ♀, 4 (?);
 Boca de Cupe, 1 ♂;
 Capeti, 2 ♂, 1 (?);
 [Lion Hill], 1 ♂, 1 ♀, 1 (?);
 New Culebra, 1 ♀;
 "Panamá," 1 (?).

G. h. aenea.—

ECUADOR:

Pambilar, 1 ♀;
 Carondelet, 1 ♂;
 San Javier, 2 ♂;
 Esmeraldas, 3 ♂.

COLOMBIA:

Barbacoas, 2 ♂;
 San José, Cauca, 1 ♂.

PANAMÁ:

Bogava, 1 ♂, 1 ♀;
 Brava Is., 1 ♀;
 Almiras Is., 3 ♂, 1 ♀.

COSTA RICA:

Guapiles, 1 ♀ ;

El Pozo, 1 ♂.

***Threnetes leucurus cervinicauda* Gould**

Threnetes cervinicauda GOULD, 1855, Proc. Zool. Soc. London, "1854," p. 109—Quijos, Ecuador.

T[hrenetes] hauxwelli BOUCARD, 1895, Genera of humming birds, p. 371—Pebas, Perú.

This form ranges down the eastern side of the Andes from Colombia to northern Perú, north of the Amazon. It has been reported from south of the Amazon in Brazil, on the Rio Juruá (Gyldenstolpe, 1945, K. Svenska Vetensk. Akad. Handl., vol. 22, no. 3, p. 73), but the assignment may be open to some question since at the same time a specimen from near Moyobamba, Perú, is also identified as *cervinicauda*. The matter is further discussed under *T. l. rufigastra* where these records may belong.

The only Peruvian record of certain assignment to *cervinicauda* is that from Pebas. Possibly some of the "Napo" specimens in various collections may have come from what is now Peruvian territory.

***Threnetes leucurus rufigastra* Cory**

Threnetes leucurus rufigastra CORY, 1915 (Aug. 7), Field Mus. Nat. Hist., ornith. ser., vol. 1, p. 303—Moyobamba, Perú, ♀ ; Chicago Nat. Hist. Mus.

The exact status of this form is far from clear. Cory described it from a single female which he found to differ from typical *leucurus* of Guiana by having the sides, flanks, and abdomen more brownish buff and the back somewhat more bronzy green. The basal markings of the tail, obviously, were white as in *leucurus* and not cinnamon buff as in *cervinicauda*. Although the color of the back appears to be of little importance, specimens with the basal white markings of the tail and the brownish buff lower under parts have since been obtained by other workers in the Moyobamba region and in southeastern Perú as well as in northern Bolivia, all of which have been assigned to *rufigastra*. To these I am able to add a bird from Lagarto, upper Ucayali, Perú.

To complicate matters, however, other specimens from the Moyobamba region and one from Lagarto have come to light which, while they have the under parts more deeply colored than in *leucurus* and many *cervinicauda*, agree with the latter in the color of the tail. At present I have no evidence of the occurrence

of such birds in southeastern Perú and northern Bolivia, but it is not impossible that the birds recorded by Gyldenstolpe from the Rio Purús (see account of *cervinicauda*) may be found to belong in this mixed assemblage. Gyldenstolpe does not comment on any distinctions from average *cervinicauda* but does refer a specimen from near Moyobamba also to *cervinicauda* along with the Purús birds.

The distinction of the cinnamon-buff-tailed birds in question from *cervinicauda* is not great. In fact, if there were no other factors involved, the recognition of a north-central Peruvian form would be of dubious value. Nevertheless, there is a certain amount of distinction. Peruvian birds from south of the Amazon, whether white-tailed or buff-tailed, have the lower under parts rather more deeply brownish buff than most Ecuadorian and Colombian specimens of *cervinicauda*, as well as all *leucurus*, although the segregation is not complete. Occasional examples from north and south of the Amazon reverse the character. In addition, the southern birds have the bright band across the lower throat deeper in color and the males have the green pectoral patch somewhat narrower, although the differences in preparation of the skins make this last feature difficult to determine.

Within the assemblage of specimens from south of the Amazon, one interesting fact has been noted. Eleven examples are now before me, comprising five cinnamon-tailed and six white-tailed birds. (The tips of the rectrices are, of course, white in all forms.) Each group includes birds of both sexes and both adults and individuals presumably not fully adult, judging by more slender and more acute rectrices, somewhat prominent pale dots at the tips of most of the remiges, or extensive buffy terminal margins on much of the dorsal plumage, sometimes with combinations of these features. All six white-tailed birds in the series in question show one or more of the signs of immaturity; the cinnamon-tailed birds are more fully adult. The series is still too small to evaluate the situation with certainty, but it appears possible that the difference in the color of the tail is due to age. Young *cervinicauda* however, are like adults of that form in respect to the color of the tail, and young and adult *leucurus* agree with each other in the same particular. Nevertheless, the complete segregation of the age groups in the present instance is such that positive confirmation or refutation becomes highly important. A specimen with the tail in molt should furnish the needed evidence.



The fact that, aside from the color of the tail, the "white-tailed" and "cinnamon-tailed" birds from south of the Amazon agree in the characters that distinguish them from *leucurus* and *cervinicauda* points with some assurance to the concept of a single subspecies with a dichromatic tail, whether it be found to be a matter of age or other cause. It is difficult to accept *leucurus* and *cervinicauda* as specifically distinct, which might be necessary if the "white-tailed" and "cinnamon-tailed" birds in Perú were kept specifically distinct, due to their occurrence together (as at Lagarto, Río Ucayali). One male from Humaythá, Rio Madeira, Brazil, is an undoubted *leucurus* but has a slight suggestion of buffy yellowish on the tail, and a female from Teffé has the belly as noticeably cinnamomeous as some of the specimens of *rufigastrea*. Furthermore, the form *medianus* of Pará is decidedly intermediate in taxonomic characters although not geographically. Elliot (1879, Smithsonian Contrib. to Knowledge, no. 317, p. 8) remarks that he had "specimens" of *leucurus* from Surinam which had buff on the rectrices. In his collection as preserved in the American Museum of Natural History are but two examples of the species labeled as from Surinam, both of which are trade-skins with consequently uncertain data. One of these is typical *leucurus*, but the other matches *medianus* so well in respect to the color of the tail and the dark hue of the belly that I believe it must belong to *medianus* and not to have originated in Surinam as claimed.

For these various reasons, therefore, I include in *rufigastrea* the various records and specimens of the species from Perú south of the Amazon and from northern Bolivia, whether with white or cinnamomeous basal markings on the tail, and suggest that the records from the Purús may equally belong to the same dichromatic (in part) form. Peruvian records that will belong here are from Moyobamba and Yahuar Mayo (white-tailed), and Roque and Chamicuros (cinnamon-tailed).

SPECIMENS EXAMINED

T. l. leucurus —

SURINAM

- Parakali, 1 (♂),
- "interior," 2 ♂, 1 [♀], 1 (♂);
- "Surinam," 1 [♂], 1 [♀]

BRITISH GUIANA

- Minnehaha Creek, 1 ♀,
- mines district, interior, 1 [♀].

VENEZUELA:

Mt. Auyan-tepui, 1 ♀;

Mt. Duida (350-750 ft.), 2 ♂, 3 ♀.

BRAZIL:

Rio Madeira, Igarapé Auará, 1 [♂], 1 ♀;

Humaythá, 1 ♂, 1 ♀;

Calamá, 1 ♂, 1 ♀;

Marmellos, 2 ♂, 1 ♀;

Paraizo, 1 ♂, 1 ♀;

Teffé, 1 ♂, 2 ♀.

No LOCALITY, 1 (?).

T. l. medianus.—

BRAZIL:

Pará, Utinga, 1 ♂;

Prata, 1 ♀.

"SURINAM," 1 [♂].

T. l. cervinicauda.—

COLOMBIA:

La Morelia, 1 ♂;

Florencia, 1 ♀;

Mt. Macarena, 1 ♀, 1 (?);

"Bogotá," 2 ♂, 1 ♀, 7 (?).

ECUADOR:

Quijos, 1 ♂;

Archidona, 1 ♂;

Río Suno, above Avila, 1 ♂, 1 ♀;

below San José, 3 ♂, 2 ♀;

Gualaquiza, 1 [♂], 1 [♀];

Canelos, 1 (?);

"Napó," 1 [♀], 2 (?).

PERÚ:

Pomará, 1 ♀;

mouth of Río Santiago, 2 ♂, 1 ♀;

mouth of Río Curaray, 1 ♀.

R. l. rufigastra.—

PERÚ:

(White-tailed):

Saposa, 2 ♂¹;

Lagarto, 1 ♀;

Candamo, 1 ♂;

La Pampa, 1 ♂.

(Buff-tailed):

Río Negro, 2 ♂;

Río Seco, 2 ♀;

Lagarto, 1 ♂.

BOLIVIA:

(White-tailed):

Todos Santos, 1 (?)¹.¹ Specimens in Academy of Natural Sciences of Philadelphia.

Phaethornis guy apicalis (Tschudi)

Tr[ochilus] apicalis "Lichtenst." TSCHUDI, 1844 (May), Arch. Naturgesch., 10th year, vol. 1, p. 296—Perú; I suggest Utcuyacu, Prov. Junín; Berlin Mus.

G[uyornis] Guyi napensis SIMON, 1921, Histoire naturelle des Trochilidae, pp. 18, 258—Napo Valley, eastern Ecuador.

Birds from Perú and eastern Ecuador appear to be inseparable in coloration and dimensions, and a few examples from the eastern side of the eastern Andes in Colombia agree with them, indicating the extension of *apicalis* at least that far to the northward. A single example from San Cristóbal, Táchira, Venezuela, in the Chicago Natural History Museum, has the bill of the same general length as these other specimens and carries the range of *apicalis* still farther to the northward.

In an earlier report (1930, Field Mus. Nat. Hist., zool. ser., vol. 17, p. 272), I commented on the difference in the lengths of bill that I found in two Peruvian birds as compared with 10 examples from Colombia, Ecuador, and Venezuela (the San Cristóbal specimen). The series then available was inadequate to establish the significance of the observed difference. With much more complete material now at hand, I am able to present more adequate data to demonstrate the reality of the distinction, although the material studied in 1930 apparently contained representatives of the two forms involved, *apicalis* and *emiliae*.

Fortunately, Bourcier and Mulsant (1846, Ann. Soc. d'Agric., Sci., Indus. Lyon, vol. 9, p. 317) give the length of the bill in the type of their *Trochilus Emiliae*, which they describe from "Bogotá," enabling us to determine to which form the name *emiliae* applies, since both it and *apicalis* are found in Bogotá collections. This length is given as 44 mm. ("0m044"). Specimens at hand from the upper Cauca Valley have the exposed culmen 40–44 mm., and 11 "Bogotá skins" range from 40 to 45. Two birds from Cunday, in the upper Magdalena Valley, show 40 mm. On the other hand, five other Bogotá specimens have the bill 35–39; three specimens from Buena Vista, above Villavicencio, 33–35; (three from Mt. Macarena are not adult and hence are inconclusive: 30–34); 19 east-Ecuadorian examples, 34–38; 10 Peruvian skins, 35–39. The San Cristóbal, Venezuelan example, according to my notes, has the bill 37 mm.; of seven Bogotá skins measured in 1930, five showed the bill 41.5–44, while two had only 36.5 and 37 (apparently representing the two subspecies);

a single Ecuadorian bird had 40 mm., the only specimen measured from that country with the bill quite that long.

It appears, therefore, that *emiliae* may be distinguished from *apicalis* by its longer bill. The Central American *coruscus* is intermediate in this respect, having the culmen 38.5–42.5, while typical *guy* of northeastern Venezuela and Trinidad is much the same as *coruscus*, with the bill 39–43 in the series measured. It may be pointed out that a male from Peque, Antioquia, Colombia, and a trade-skin, presumably also from the Antioquia region, agree closely with *coruscus* in distinction from the upper Cauca Valley examples of *emiliae*.

A word may be said concerning the restricted type locality of the species and nominate subspecies. Lesson (1833, *Les Trochilidées*, p. 119, and "Index," p. "xiv") described *Trochilus Guy* from "Le Brésil." The locality was eventually discovered to be erroneous and the correct range of the bird determined as Trinidad and northeastern Venezuela, but Hellmayr (1906, *Novitates Zool.*, vol. 13, p. 34) appears to have been the first to propose a formal substitution of Trinidad for "Le Brésil."

A single specimen from Huiro, southeastern Perú, has a pronounced brownish coloration beneath that I am unable to match even in typical *g. guy*. The bird is sexed as a male and if correctly so it is undoubtedly immature, which a certain laxness of plumage also suggests. A series from southeastern Perú might show some constancy in the brown tones that would be of significance, but I can find no mention of such characteristics in earlier citations of southeast-Peruvian specimens.

Records of *apicalis* are from Huaynapata, Río Cadena, San Antonio, Marcapata, Río San Miguel, La Gloria, Soriano, and Huambo.

SPECIMENS EXAMINED

P. g. guy.—

TRINIDAD:

Aripo, 2 ♂, 1 (?);
Savanna Grande, 3 ♂;
Carenage, 1 ♂, 1 ♀;
Princetown, 1 (?);
"Trinidad," 1 ♂, 2 (?).

VENEZUELA:

Cumanacoa, 1 [♂], 1 ♀;
Cumaná, 1 (?);
Quebrada Seca, 3 ♂, 1 ♀;

La Tigra, 1 ♂;
Cristóbal Colón, 2 ♂, 4 ♀;
Yacua, 1 ♂;
"Venezuela," 1 (?).

P. g. apicalis.—

VENEZUELA:

San Cristóbal, Táchira, 1 [♂]¹.

COLOMBIA:

Buena Vista, above Villavicencio, 1 ♀, 2 [♀];
Mt. Macarena, 2 ♂, 1 ♀;
"Bogotá," 4 [♂], 1 [♀].

ECUADOR:

Cerro Galeras, 1 ♂;
Río Suno, above Avila, 2 ♀;
below San José, 7 ♂, 4 ♀;
above Archidona, 1 ♀;
Ambato, 1 [♂];
Zamora, 2 ♂, 1 ♀.

PERÚ:

Uchco, east of Chachapoyas, 1 ♂, 1 (?);
Huarandosa, 5 ♂;
Vista Alcgre, 1 ♀¹;
Chinchao, 1 ♀¹;
Utcuyacu, 1 ♂;
Tulumayo, 1 ♂;
Pozuzo, 2 ♂;
Huiro, 1 ♂.

P. g. emiliae.—

COLOMBIA:

Cunday, 1 [♂], 1 [♀];
"Bogotá," 6 [♂], 7 [♀];
within 20 miles of Honda, 1 ♂;
Miraflores, 1 ♀, 2 (?);
Las Lomitas, 3 ♂, 1 ♀;
San Antonio, 2 ♂.

P. g. coruscus.—

COLOMBIA:

Peque, 1 ♂;
? Antioquia, 1 ♂;
east slope of Tacarcuna, 3 ♂.

PANAMÁ:

Tacarcuna, 3 ♂, 8 ♀;
Cituro, 1 ♂;
Chiriquí, 1 ♂, 1 [♀];
Boquete, 1 ♂, 1 [♀];
Calovevora, 1 [♀];
Veragua, 1 ♂;
Chitrá, 3 ♂, 3 ♀;

¹ Specimens in Chicago Natural History Museum.

Santa Fé, Veragua, 4 ♂, 1 ♀, 1 (?);

Río Calovevora, 1 ♂, 1 ?♂, 2 ♀.

COSTA RICA:

(Turrialba, Guayabo, Hacienda Iberia, Bonilla, Dota Mts., Aquinares, Barranca, Coliblanco de Sarapiquí, Carrillo, Azahar de Cartago, and La Hondura), 20 ♂, 13 ♀.

***Phaethornis syrmatophorus columbianus* Boucard**

Phaethornis columbianus BOUCARD, 1891 (March 1), Humming Bird, vol. 1, no. 3, p. 17—"Columbia"; received from Bogotá; I suggest La Palma, Huila, Colombia, as restricted type locality; type in Paris Mus.

Phaethornis syrmatophorus huallagae CARRIKER, 1935 (Oct. 25), Proc. Acad. Nat. Sci. Philadelphia, vol. 87, p. 344—Río Jelashte, Dept. San Martín, Perú; ♂; Acad. Nat. Sci. Philadelphia.

Two paratypes of *huallagae*, kindly lent by Mr. deSchauensee of the Academy of Natural Sciences of Philadelphia, have been compared with a series of east-Ecuadorian birds and two Colombian examples of the present form. I can find no adequate characters for the recognition of *huallagae*. One of the Peruvian birds, a female, is a little darker on the upper surface than the other, older skins, which vary considerably among themselves. The other Peruvian example is immature and matches comparable *columbianus* rather exactly. Typical *syrmatophorus* exhibits the same range of color on the mantle, as is shown by the present series. In the original description of *huallagae*, no mention is made of *columbianus*, but, instead, the distinctions from *s. syrmatophorus* are used as the basis for recognition of the supposed new form.

One of the Colombian examples of this form at hand is a "Bogotá" trade-skin, but at the same time three other "Bogotá" skins belong to *s. syrmatophorus*. The proportion, in view of the known ranges of the two forms, is curious but probably not significant. Since both forms occur in "Bogotá" collections, I have thought it advisable to suggest La Palma as a restricted type locality for *columbianus*.

There are no Peruvian records of the species except from Río Jelashte.

SPECIMENS EXAMINED

P. s. syrmatophorus.—

COLOMBIA:

Cocal, 1 ♀;

Salento, 1 ♂;

Cerro Munchique, 1 ♂, 1 ♀;

San Antonio, Cauca, 1 ♂, 2 ♀;
 La Costa, El Tambo, Cauca, 1 ♂;
 Alto de las Cruces (w. cordillera), 1 (?);
 "Bogotá," 3 (?).

ECUADOR:

Río Pescado, 3 ♂ (including type of "*berlepschi*"), 2 ♀, 1 (?);
 Gualea, 1 ♂;
 "Quito," 1 ♂, 1 (?).

NO LOCALITY: 1 (?).

P. s. columbianus.—

COLOMBIA:

La Palma, 1 ♀;
 "Bogotá," 1 (?).

ECUADOR:

Upper Sumaco, 1 ♂;
 lower Sumaco, 2 ♂;
 Baeza, 4 ♂, 1 ♀;
 below Baeza, 1 ♂;
 east of Baños, 5 ♂, 1 ♀.

PERÚ:

Río Jelashte, 1 ♂¹, 1 ♀¹.

***Phaethornis malaris moorei* Lawrence**

Phaethornis moorei LAWRENCE, 1858, Ann. Lyc. Nat. Hist. New York, vol. 6, p. 258—Ecuador (type labeled "Napo"); [? ♂]; Amer. Mus. Nat. Hist.

Phaethornis superciliosa Moorei var. *nigella* SIMON, 1921, Histoire naturelle des Trochilidae, pp. 13, 252—Bogotá.

The present form ranges from the eastern side of the Eastern Andes of Colombia (at least in the southern part of the country) southward across eastern Ecuador to the north bank of the Amazon in northern Perú and westernmost Brazil, although in the Peruvian part of its range it appears not to reach the left bank of the Marañón farther than somewhere near the mouth of the Río Santiago. A single specimen from Pomará, farther upstream, belongs to a different subspecies, as will be noted below.

Specimens from the range indicated agree well among themselves and appear to represent but a single form. Judging by the measurements of the type, which is a non-sexed specimen, it is a male. The wing measures 64 mm., which is average for the males (59–65) but longer than in any female examined (55–61.5). As other of W. E. Moore's "Napo" birds, it may have come from what is now Perú, but since Moore is reported to have traveled the whole length of the Napo, this is uncertain, and the locality may be left within Ecuadorian boundaries.

Specimens in Academy of Natural Sciences of Philadelphia.

The placement of *moorei* with *malaris* rather than with *superciliosus* hinges on an intermediate new form from the Casiquiare region of Venezuela in the discussion of which the matter is treated in detail. The account of this new form follows.

Peruvian records that should belong to *moorei* are from Nauta and Iquitos.

***Phaethornis malaris insolitus*, new subspecies**

TYPE: From Río Huaynia, junction with Río Casiquiare, right bank (west bank), Venezuela. No. 431897, American Museum of Natural History. Adult male collected May 9, 1929, by the Olalla brothers.

DIAGNOSIS: Most nearly resembling *P. m. malaris* of Cayenne but somewhat smaller, especially in length of bill; central gular streak of males usually more pronounced; under tail-coverts averaging lighter ochraceous and terminal margins of outer four pairs of rectrices less deeply rufescent; top of head more dusky, less strongly glossed with green; malar and supra-auricular stripes often more buffy, less whitish.

RANGE: Known only from the western side of the upper Rio Negro, the Casiquiare, and the uppermost Orinoco in Venezuela, Brazil, and Colombia.

DESCRIPTION OF TYPE: Top of head blackish with a faint greenish gloss, more pronounced on the hind neck where the feathers have narrow dusky terminal margins; mantle glossy Roman Green, with similar dark margins; rump similar but with cinnamonaceous buff margins beyond the dark border; upper tail-coverts with the dark and cinnamonaceous margins broader. Lores and auriculars black, connected by a black stripe under the eye; above the auriculars a broad stripe of Cinnamon-Buff; a somewhat lighter and narrower stripe from the base of the bill below the black facial area to the mid-point below the auriculars; sides of throat anteriorly broadly blackish becoming lighter posteriorly and with an inconspicuous median streak of dull brownish buff; breast light buffy brown, darker on the sides, and passing into a brighter Pinkish Buff × Cinnamon-Buff on the belly; under tail-coverts near Pinkish Buff, with brownish shaft stripes. Remiges blackish, with a purplish luster; outer primary with fine, pale outer margin; greater upper coverts and primary-coverts similar; remainder of upper coverts green like the mantle; under wing-coverts largely blackish, with a fine buffy brown line along

the carpal margin. Rectrices basally grayish green, followed by a subterminal area of black on the elongated median rectrices; this black area passes into white over most of the narrowed terminal prolongation; on the remaining four pairs there is a latero-terminal patch of rufescent buff on each web narrowly connected across the tip of the feather. Maxilla (in dried skin) black; mandible yellowish, becoming blackish brown distally; feet yellowish brown. Wing, 67 mm.; tail, 70.5; culmen, 38.5.

REMARKS. Females are slightly smaller, with shorter and more arcuate bill, and have less pronounced black on the throat, but the under tail-coverts are ochraceous as in the males. Except for this last feature and the rufescent terminal markings on the four outer pairs of rectrices they resemble the males of *P. s. superciliosus*. Young birds have the cinnamon-buff terminal margins of the uropygium broader than in adults and present also on the feathers of the mantle and top of the head.

The discovery of this form opened an intensive study of *malaris* and *superciliosus* that has led to the conclusion that most of the subspecies usually assigned to conspecific association with *superciliosus* show greater affinity to *malaris*, excepting only *saturation* of the upper Orinoco and Caura regions of Venezuela. It appeared even that it might be possible to consider *malaris* and *superciliosus* as terminal forms of a "ring species," having a common origin and eventually finding themselves side by side, as it appears they exist in Cayenne. There is no doubt that some of the forms show one or more of the characters of *superciliosus* while retaining others of *malaris*, but in the main their relationship is fairly clear, and I believe that the two species are, indeed, closely related but still distinct enough to maintain their specific rank.

One of the first characters to come to notice in the distinction of the two species is the greater curvature of the bill in *superciliosus* and *saturation*, coupled usually with shorter length. When comparative observations of the bill are made, it is important to keep the sexes distinct. In both *malaris* (and its affines) and *superciliosus* (and *saturation*) the bill of the female averages both shorter and more curved than that of the male, and is often pronouncedly so. Consequently a female of the *malaris* group may have a bill approximating the shape and dimensions of that of a male of *superciliosus*.

A second important character, subject to some variation, is the color of the under tail-coverts and the terminal spots on the

outer four pairs of rectrices. In *superciliosus* and *saturator* these areas are distinctly whitish, although there is sometimes a buffy tinge on the coverts or a trace of rufescence on the rectrices. In most of the *malaris* group, the under tail-coverts are buffy or ochraceous, sometimes deeply so, sometimes of a paler tint, and the tail markings show varying degrees of rufescence but are rarely all white except in *baroni* of western Ecuador and northwestern Perú, and, as far as the tail-coverts are concerned, in *muelleri* of the south bank of the lower Amazon. As a matter of fact, a female of typical *malaris* from Cayenne has both under tail-coverts and tail markings very nearly white, although other features and size point to its proper identity.

Other than these features, the members of the *malaris* group usually show more heavily shaded sides of the throat and broader (as well as more rufescent) tail markings, although these characters are far from constant within any population. The strong greenish gloss on the top of the head in *m. malaris* appears not to be duplicated except in the distant *malaris mexicanus*.

As far as present material demonstrates, the present form, *insolitus*, is confined to the western side of the Orinoco-Casiquiare-Negro river system, while *superciliosus* occupies the eastern side. It is possible, however, that this geographical segregation will not be found exact. Pelzeln (1868, *Zur Ornithologie Brasiliens*, p. 27), reported a specimen of *superciliosus* from Marabitanas, which is in the range of *insolitus*, and Hellmayr (1906, *Novitates Zool.*, vol. 13, p. 374) comments on this specimen, among others, without finding any distinction from Guianan *superciliosus*. Likewise, the hiatus between the known range of *insolitus* and that of *malaris* is such that a connectant population may yet be found there. It may be argued, of course, that *superciliosus* presumably occupies this area and that the apparent geographical replacement of it by *insolitus* across the Orinoco-Casiquiare-Negro river complex indicates that *insolitus* and *superciliosus* are conspecific rather than *insolitus* and *malaris*. Nevertheless, I believe that the relationship is as I have postulated.

The measurements of the pertinent forms, as nearly as I can determine them, are given in table 1.

To augment the limited number of specimens of *m. malaris* available for measurement, I have included the figures given by Berlepsch (1908, *Novitates Zool.*, vol. 15, p. 262).

The difference in the lengths of bill in *superciliosus* and *satura-*

TABLE 1
COMPARATIVE MEASUREMENTS, IN MILLIMETERS (AVERAGES IN PARENTHESES)

	Wing	Tail	Culmen
<i>s. superciliosus</i>			
Males	57 -63 (60.1)	62 -71.5 (66.8)	34 -39.5 (37.4)
Females	54 -62 (58.7)	60 -71 (65.8)	33 -37 (34.8)
<i>s. saturator</i>			
Males	56 -62 (59.0)	62 -70 (66.3)	33 -37 (35.3)
Females	55 -59 (57.2)	62.5-66 (64.1)	32.5-35 (33.8)
<i>m. malaris</i>			
Males	65.5-70 (67.0)	73.5-75.5 (74.8)	45 -46 (45.5)
Females	61 -66.5 (63.6)	69 -75 (73.1)	40 -43.5 (42.3)
<i>m. insolitus</i>			
Males	62 -67 (64.7)	64.5-70.5 (67.9)	38 -42.5 (40.0)
Females	61 -63 (64.0)	67	35 -37 (36.0)
<i>m. moorei</i>			
Males	59 -65.25 (63.4)	61 -69 (64.8)	38 -43 (40.7)
Females	59 -61.5 (60.1)	62.5-66 (64.1)	36 -38.5 (37.8)

tior is somewhat more positive than the above figures may indicate. Of 34 males of *superciliosus*, 30 have the culmen over 36 mm. in length; 11 of 12 *saturator* have a measurement of 36 mm. or less. The slightly deeper ventral coloration of *saturator* supplements this distinction. The measurements of wing and tail are too nearly the same in both forms to serve as criteria.

I believe that the Central American forms, *m. cephalus* and *m. cassinii*, have somewhat different distributional limits than those usually attributed to them. The material at hand indicates that *cephalus*, in Panamá, occupies only the Pacific side of the cordillera west of the Canal Zone, while *cassinii* crosses the Canal Zone from the east and occupies the Caribbean slopes westward to Almirante, and apparently a portion of the Cape Mala Peninsula on the Pacific side. Three specimens from Cerro Montoso, Cape Mala Peninsula, are as dark as east-Panamanian skins, while two from La Marea, 20 miles south of Santiago, not far distant, are among the lightest examples of *cephalus*. As pointed out by Griscom (1932, Bull. Mus. Comp. Zool., vol. 72, p. 329), there is considerable confusion in the Central American forms, and I am not sure that *cassinii* and *cephalus* deserve separate recognition.

It is possible that there is a minor confusion with respect to the type locality of *cassinii*. Lawrence (1866, Ann. Lyc. Nat. Hist. New York, vol. 8, pp. 347-348) cites the "Habitat" of the form as "New Granada, Carthagená" and states that since the male

(of the two examples he had in hand) was in such poor condition, he selected the female as type. The male was from Turbo, but since Lawrence particularly called attention to that fact, it is presumed that the female was from Carthagera. Unfortunately he cited the same Smithsonian Museum catalogue number for both birds—17918. Later, Berlepsch (1888, Proc. U. S. Natl. Mus., vol. 11, p. 560) gives critical remarks on the male which he took for the type, and Ridgway (1911, Bull. U. S. Natl. Mus., no. 50, pp. 321–322) gives Turbo as the only Colombian locality for what he calls *cephalus*, although strangely enough he does not cite the name *cassinii* in the synonymy. It seems certain that Lawrence's male specimen is not the type of *cassinii* and that Carthagera and not Turbo is the type locality.

***Phaethornis malaris ucayalii*, new subspecies**

TYPE: From Lagarto, right bank of the upper Río Ucayali, Perú. No. 238865, American Museum of Natural History. Adult male collected March 11, 1928, by Carlos Olalla and sons.

DIAGNOSIS: Intermediate between *P. m. moorei* of the Río Napo and *P. m. ochraceiventris* of the south bank of the Amazon from northeastern Perú to the Rio Madeira, Brazil. Dorsal coloration more coppery than in *moorei* and under parts decidedly more ochraceous, less grayish. Dorsal coloration about as in *ochraceiventris* but under parts duller, less brightly ochraceous.

Compared with *P. m. bolivianus* of southeastern Perú and northern Bolivia, the bill is longer (although the general size is only slightly larger); the uropygial area is duller, less brightly cinnamonaceous, and more sharply barred as a rule; the under tail-coverts are a little paler buff, and the latero-terminal margins of the four outer pairs of rectrices are less strongly rufescent and show a greater amount of white or whitish tendency.

RANGE: Perú south of the Amazon (including the west bank of the middle Marañón), east to the Río Ucayali (both banks), and south to the Chanchamayo Valley.

DESCRIPTION OF TYPE: Pattern as described for *insolitus* with colors differing as follows. Top of head dusky brown with slight bronzy lights; hind neck and mantle near Medal Bronze with coppery reflections. Supra-auricular and malar stripes Pinkish Buff; sides of throat buffy gray with blackish subterminal portions of the feathers not entirely concealed; median gular stripe obvious, Pale Pinkish Buff; breast near Pinkish Buff,

darker on the sides; belly deeper in tone; under tail-coverts buff with dusky shaft stripe; latero-terminal margins of outer four pairs of rectrices cinnameous, somewhat paler on submedian pair than on outermost. Bill and feet as in *insolitus*. Wing, 64 mm.; tail, 61.5; culmen, 40.

REMARKS: The females appear to average darker below than the males, with the sides of the throat more pronouncedly dusky, giving a marked suggestion of *baroni* of the western side of the Western Andes. As in the other forms, this sex is a little smaller than the male sex and has the bill shorter and more curved as a rule. Two examples at hand on all these counts have been wrongly sexed as males. The rest of the series show the characters mentioned.

The available series shows the following measurements: males, wing, 59–65 mm. (average, 62.8); tail, 62–68 (65.1); culmen, 39.5–41 (40.0); females, wing, 59–63 (71.0); tail, 60–65.5 (63.1); culmen, 37–41 (38.9). Measurements of *bolivianus* are given under that form.

One male from the type locality shows an unusual depth of ochraceous coloration on the under side, approaching *ochraceiventris*, but it is still not so deeply colored as the type of that form and three other specimens in agreement with it, discussed under the heading of that form.

Although *moorei* follows the north bank of the Amazon at least as far west as the mouth of the Río Santiago and might be expected to pass beyond that point to the left bank of the middle Marañón, a male at hand from Pomará is exactly like the Ucayali birds in clear distinction from the east-Ecuadorian form. Presumably, therefore, *ucayalii* occupies the northern part of Perú south of the Amazon from just west of the Marañón to the eastern side of the Ucayali. Accordingly, records from Yurimaguas, Jeberos, Chayavitas, and "Peruvian Amazons" may be placed under the present form.

The records from "Peruvian Amazons" are of specimens collected by Bartlett whose only definite localities of record for Peruvian specimens of this group are from Jeberos and Chayavitas. It is possible that he may have obtained examples of *moorei* from north of the Amazon in Perú, but in the absence of certainty, the Bartlett records may be placed here. There is a more dubious record of a specimen collected by Jelski, ostensibly at Lima (Taczanowski, 1874, Proc. Zool. Soc. London, p. 541). The

locality is highly questionable, and Taczanowski later (1884, *Ornithologie du Pérou*, vol. 1, p. 265) cites only "Pérou central" as credited to Jelski. Berlepsch (Berlepsch and Stolzmann, 1892, *Proc. Zool. Soc. London*, p. 401) examined the specimen in question (a mounted bird without original label) and concluded that its country of origin was Cayenne, which Jelski had visited immediately prior to his journey to Lima, but Taczanowski, in a letter to Berlepsch, insisted on the central Peruvian origin. Since the specimen presumably no longer exists, exact determination is now impossible except in the realization that "Lima" must have been an error.

***Phaethornis malaris ochraceiventris* Hellmayr**

Phaethornis affinis ochraceiventris HELLMAYR, 1907 (Feb. 28), *Bull. Brit. Ornith. Club*, vol. 19, p. 54—Humaythá, Rio Madeira (left bank), Brazil; *Amer. Mus. Nat. Hist.*

A single specimen from Orosa, south bank of the Amazon, northeastern Perú, is in good agreement with three Brazilian specimens of this form, including the type, and apparently indicates the approximate western limit of range. The Orosa specimen has the back greener than that of any of the three other examples, but the same type of variation exists in *ucayalii* and *bolivianus*, both of which have the dorsum commonly coppery but sometimes green. All four specimens have the under parts more pronouncedly cinnameous than any other form of the species, and the latero-terminal margins of the outer four pairs of rectrices and the under tail-coverts also at a maximum depth of coloration. Judging by the slightly shorter and somewhat more arcuate bill of the type, I suspect it to be a female; it was not sexed by the collector.

As suspected by Todd (1937, *Ann. Carnegie Mus.*, vol. 25, p. 247) the female from Calamá, east bank of the Madeira, Brazil, which Hellmayr assigned to *ochraceiventris*, is best referred to *insignis*. However, both it and a male from Borba, also east bank of the Madeira, have the mantle bronzy as in most *ochraceiventris*, while three skins of *insignis* from the left bank of the Rio Tapajoz have this area green, a character mentioned by Todd in the description of *insignis*, although, as noted above, the dorsal color is not perfectly constant in *ochraceiventris* and some other forms. Nevertheless, the character of the Borba and Ca-

lamá birds may be one of intermediacy between the two adjacent forms mentioned.

Phaethornis malaris bolivianus Gould

Phaethornis Boliviana GOULD, 1861, Introduction to the Trochilidae, p. 42—Bolivia; British Mus.

Specimens from the southeastern corner of Perú are somewhat intermediate between *ucayalii* and Bolivian examples of *bolivianus* but agree better with the latter. In addition to their short bills, they have the uropygial area usually brighter than in *ucayalii* and with the bright portion of the feathers more extensive and the dark bars less prominent, and the latero-terminal margins of the outer rectrices more deeply rufescent. The under tail-coverts also are more deeply ochraceous, on average, than in *ucayalii*, although those of the Bolivian examples are somewhat deeper. The general color of the under parts averages a little lighter and clearer than in *ucayalii*, but the resemblance is close, and the upper parts are equally coppery, though occasionally definitely green in both forms.

The only Peruvian record assignable to *bolivianus* is from Cosñipata, based on specimens collected by Whitely, one of which is before me.

The series at hand shows the following measurements: males, wing, 61.5–64 mm. (average, 62.5); tail, 63.5–66 (64.9); culmen, 35–38 (36.3); females, wing, 56–59 (57.0); tail, 59–65 (62.8); culmen, 33–36 (34.5).

Phaethornis malaris baroni Hartert

Phaethornis baroni HARTERT, 1897, Ibis, ser. 7, vol. 3, p. 426—Naranjal, Río Pescada, western Ecuador; Amer. Mus. Nat. Hist.

This form has the latero-terminal spots of the outer four pairs of rectrices white, rarely with a trace of cinnamon, and the under tail-coverts also are white more often than not though sometimes pale buff. The central gular stripe is strong and buffy and the sides of the throat are heavily shaded, while the breast shows more prominent dusky tips on the feathers than is usual in the species, most members of which show indications of the same marking. The belly also is whitish or weakly ochraceous tinged, while the upper tail-coverts have quite extensive ochraceous or cinnamonous areas. It is a well-marked form but certainly a geographic representative of the *malaris* group.

The realignment of the boundary between Ecuador and Perú has brought *baroni* into the Peruvian avifauna on the basis of three localities from which specimens are at hand. These localities were so close to the former boundary that the occurrence of the subspecies on the Peruvian side of the line was to be expected, although no specimens had actually been obtained there.

SPECIMENS EXAMINED

P. malaris mexicanus.—

MÉXICO:

Dos Arroyos, Chilpancingo, Guerrero, 2 (?) (including type).

P. m. veraecrucis.—

MÉXICO:

Mineral San Sebastian, Jalisco, 1 ♀ ;

"México," 1 ♂.

P. m. longirostris.—

GUATEMALA:

(Secanquim, Vera Paz, and Coban), 8 ♂, 3 [? ♀], 6 (?).

P. m. cephalus.—

NICARAGUA:

(Río Coco, Savala, San Rafael del Norte, Matagalpa, Tuma, and Los Sabalos), 6 ♂, 1 "♂" [= ♀], 2 ♀, 1 ? ♀.

COSTA RICA:

(Pozo del Río Grande, Orotina, Parismina, Puerto Jiménez, Guapiles, El Pozo, Atalanta, Volcán de Oso, Palmar, Pozo Azul de Pirris, Miravalles, Siquirres, and Boruca), 17 ♂, 6 ♀, 3 (?).

PANAMÁ:

(La Marea, Bogava, Boquete, Chiriquí, Wilcox Camp, and "Panamá"), 1 ♂, 4 ♀, 3 (?).

P. m. cassinii.—

PANAMÁ:

(Almirante, Cocoplum, Cerro Montoso, Río Calovevora, Capeti, Cape Garachiné, Tapalisa, and El Real, Río Tuyra), 12 ♂, 2 ♀, 1 ? ♀, 1 [♀].

COLOMBIA:

Bahia de Solano, 1 ♂.

P. m. susurrus.—

COLOMBIA:

(Santa Marta, Cacagualito, and Las Nubes), 5 ♂, 4 (?).

P. m. malaris.—

CAYENNE:

(Pied Saut, Ipousin, Roche Marie, and "Cayenne"), 2 ♂, 2 [♂], 3 ♀, 1 [♀], 1 (?).

P. m. insolitus.—

VENEZUELA:

Río Huaynia, junction with the Casiquiare, 7 ♂ (including type); terrain between junction of Huaynia and Casiquiare, 1 ♀ ;

Yavita-Piminchin portage, 3 ♂¹, 1 ♀¹, 2 (?)¹;

El Carmen, Río Negro, 1 (?)¹;

San Carlos, Río Negro, 1 (?)¹.

COLOMBIA:

Mouth of Casiquiare, 1 ♂.

BRAZIL:

Tahuapunto, Rio Uaupés, 1 ♂, 1 ♀;

Tabocal, 2 ♂.

P. m. moorei.—

COLOMBIA:

La Morelia, 2 ♂;

Florencia, 2 ♀;

"Bogotá," 2 (?).

ECUADOR:

"Napo," 1 ♂ (type), 2 (?);

"Quito," 2 (?);

Río Suno, above Avila, 3 ♂, 2 ♀;

lower Río Suno, 3 ♂;

below San José, 5 ♂, 1 ♀.

PERÚ:

Puerto Indiana, 1 ♂;

Pebas, 1 ♂;

Apayacu, 1 ♂, 1 ♀;

mouth of Río Curaray, 8 ♂, 2 ♀;

mouth of Río Santiago, 1 ♂.

BRAZIL:

Tonantins, 5 ♂².

P. m. baroni.—

ECUADOR:

Naranjal, 1 (?) (type);

(Chone, Esmeraldas, Santa Rosa, Chongon Hills, "Quito," and "N Ecuador"), 4 ♂, 4 ♀, 3 (?).

PERÚ:

Alamor, 1 ♂, 1 ♀;

Guainche, 2 ♂;

Cebollal, 1 ♂.

P. m. ucayalii.—

PERÚ:

Pomará, 1 ♂;

Lagarto, 5 ♂ (including type), 1 "♂" [= ♀];

Santa Rosa (Ucayali), 1 "♂" [= ♀], 3 ♀;

mouth of Río Urubamba, 1 ♂;

Chuchurras, 1 ♂;

Chanchamayo, 2 ♀;

Río Tapiche, 1 (?);

"Perú" [probably Jeberos or Chayavitas], 1 (?).

¹ Specimens in collection of W. H. Phelps, Caracas, Venezuela.

² Specimens in Carnegie Museum, Pittsburgh.

P. m. bolivianus —

PERÚ:

- Cosñipata, 1 ♂;
 Astillero, 2 ♂, 4 ♀;
 La Pampa, 1 ♂, 1 ♀;
 Candamo, 1 ♂, 1 [? ♀].

BOLIVIA:

- Tres Arroyos, 1 ♀, 1 (?);
 Santa Cruz, Cochabamba, 1 ♂;
 mouth of Río San Antonio, 1 ♂.

P. m. ochraceiventris. —

PERÚ:

- Orosa, 1 ♂.

BRAZIL:

- Teffé, 1 ♂;
 Humaythá, 1 ♂, 1 [? ♀] (type).

P. m. insignis. —

BRAZIL:

- Calamá, 1 ♀;
 Borba, 1 ♂;
 Rio Tapajoz, Limoál, 1 ♂, 2 ♀.

P. m. muelleri. —

BRAZIL:

- Rio Tapajoz, Aramanay, 1 ♀;
 Pará, Utinga, 1 ♂;
 Prata, 1 ♂, 1 ? ♀.

P. s. superciliosus. —

CAYENNE:

- (Pied Saut, Ipousin, and "Cayenne"), 2 ♂, 1 ♀, 2 (?).

SURINAM:

- Rijweg, 1 ♂.

BRITISH GUIANA:

- (Annai, Ourumee, Essequibo River, Atapurau River, Tumatumari, Minnehaha Creek), 6 ♂, 1 ♀, 1 (?).

VENEZUELA:

- Mt. Auyan-tepui, 2 ♂, 2 ♀;
 Mt. Duida, (Río Pescada, Pie del Cerro, Playa del Río Base, Valle de los Monos, and Caño Seco), 20 ♂, 4 ♀;
 Río Orinoco, mouth of Río Ocamo, 1 ♂;
 Río Paragua, Raudal Guaiquinima, 1 ♂¹;
 Vaipan-tepui, Bolívar, 1 (?)¹.

BRAZIL:

- Rio Negro, Cucuhy, 1 ♂, 1 ♀;
 São Gabriel, 1 ♂, 1 ♀;
 Campos Salles, Manaus, 5 ♂, 2 ♀;
 Rio Jamundá, Faro, 1 ♂, 2 ♀.

¹ Specimens in collection of W. H. Phelps, Caracas, Venezuela.

P. s. saturator.—

VENEZUELA:

Río Orinoco, Nericagua, 5 ♂, 5 ♀ ;

Munduapo, 6 ♂ ;

Río Caura, La Prisión, 1 ♂, 1 ♀, 2 (?) ;

Suapure, 4 ♂, 4 ♀ .

***Phaethornis hispidus* (Gould)**

Trochilus (—?) *hispidus* GOULD, 1846, Proc. Zool. Soc. London, pt. 14, p. 90—Perú?; *errore*—type from Bolivia; British Mus.

Trochilus oseryi BOURCIER AND MULSANT, 1852, Ann. Soc. d'Agric., Sci., Indus. Lyon, ser. 2, vol. 4, p. 139—banks of the Río Pastaza, Ecuador, type lost?

Phaethornis villosus LAWRENCE, Ann. Lyc. Nat. Hist. New York, vol. 6, p. 259—"Ecuador. Santa Fe de Bogota"; type from "Napo"; Amer. Mus. Nat. Hist.

Mouth of Río Curaray, 3 ♂, 2 ♀ ; Puerto Indiana, 1 ♂ ; "Perú" (= probably Pebas), 1 ♂ ; Samiria, 1 ♂ ; Sarayacu, 1 ♂, 1 ♀ ; Lagarto, 2 ♂ ; mouth of Río Urubamba, 1 ♂ ; Pachisa, 1 ♂ ; Astillero, 1 ♂ .

I can find no clear distinctions in over 80 specimens from southwestern Venezuela, eastern Colombia, eastern Ecuador, northern Bolivia, and the Peruvian localities listed above. The supposed character of buff instead of hoary or whitish tips on the uropygial feathers of "*villosus*" claimed by Hellmayr (1910, Novitates Zool., vol. 17, p. 374) appears to be a sign of immaturity and occurs throughout the range.

Lawrence did not specify the number of specimens he possessed of his "*villosus*," but only one example of his former specimens is marked in his handwriting as "Type of *villosus*"—a Napo specimen collected by W. E. Moore.

Additional records of *hispidus* are from Pebas, upper Ucayali near Cashiboya, Yurimaguas, and Iquitos.

The neighborhood of Mt. Duida, Venezuela, may be added to the known range of the species. Specimens are at hand from Caño León and Valle de los Monos on Mt. Duida, Lalaja and the mouth of the Río Ocamo on the Orinoco, and El Merey on the Casiquiare.

***Phaethornis bourcieri bourcieri* (Lesson)**

Trochilus Bourcieri LESSON, 1832, Les Trochilidées, p. 62, pl. 18—"le Brésil."

Ametornis abnormis PELZELN, 1868, Zur Ornithologie Brasiliens, pp. 27, 56—Marabitanas, Brazil; ♂ ; Vienna Mus.

Griscom and Greenway (1941, Bull. Mus. Comp. Zool., vol. 88, no. 3, p. 168) selected the Rio Tapajoz, Brazil, as type locality of this form, and Friedmann (1948, Proc. U. S. Natl. Mus., vol. 97, p. 420) suggested the desirability of still further restriction to Aramanay, the locality from which Griscom and Greenway apparently had the single specimen on which they based their proposal. I find myself unable to accept this restriction on the basis of the evidence submitted, but refrain from making an alternative proposal, at least until more is known of the lower-Amazonian distribution of the species. I have doubts that the supposed Aramanay specimen is correctly labeled. If *bourcieri* occurs in the neighborhood of Santarem (near Aramanay), it would be very strange if the abundant material that has come from that region in years past failed to include it. There is no other evidence that the species reaches the Amazon Valley except far back toward the eastern face of the Andes. I believe the Aramanay record and type locality restriction are best held in abeyance until supporting evidence is forthcoming.

I find the racial segregation of *P. b. whitelyi* Boucard [1891, Humming Bird, vol. 1, p. 18—Roraima, "British Guiana" (= Venezuela)] fairly complete if it is restricted to the birds from the Guianas, but not otherwise. Specimens from the upper Rio Negro, Brazil, and the neighborhood of the Casiquiare and Mt. Duida, Venezuela, are definitely like Ecuadorian and Peruvian specimens and, in fact, include some of the most sharply marked examples with the grayish tone of the under parts, the clear white gular stripe, and the whitish belly. Four southeast-Colombian birds are in poor condition, and one of them, it must be admitted, shows a close approach to *whitelyi*, but others from the same locality (La Morelia) do not. The color of the upper parts is inconclusive for, although typical *bourcieri* more often than not has the back dark green while *whitelyi* tends toward a more golden green coloration, both extremes occur in both series. One bird labeled "Peru" is an undoubted Cayenne trade-skin and agrees with other Cayenne material.

Pelzel's description of the gular area in his Marabitanas bird shows that example to have resembled *bourcieri* rather than *whitelyi*.

Peruvian records are from Jeberos, Chayavitas, Chamicuros, and Yurimaguas. Apparently it does not extend eastward on the south bank of the Amazon as far as the Ucayali.

SPECIMENS EXAMINED

P. b. bourcierii.—

PERÚ:

Apayacu, 1 ♂;
Puerto Indiana, 1 ♂;
mouth of Río Curaray, 2 ♂.

ECUADOR

Río Suno, above Avila, 4 ♂, 2 ♀;
below San José, 6 ♂.

COLOMBIA:

La Morelia, 3 ♂;
Florencia, 1 ♂.

BRAZIL:

Rio Negro, Tatú, 1 ♂, 1 ♀

VENEZUELA:

Buena Vista, Río Casiquiare, 1 ♂;
opposite El Meray, 1 ♂;
Río Orinoco, mouth of Río Ocamo, 1 ♂;
Mt. Duida, [western] foot, 1 ♂;
Valle de los Monos, 1 ♀;
Campamento del Medio, 1 ♂, 1 ♀.

P. b. whitelyi.—

CAYENNE:

Ipousin, 1 ♂;
"Cayenne," 3 (?);
"Peru" [= Cayenne], 1 (?).

BRITISH GUIANA:

Minnehaha Creek, 1 ♀;
Kamakusa, 1 (?);
Merume Mts., 1 (?).

***Phaethornis philippii* (Bourcier)**

Trochilus Philippii BOURCIER, 1847, Ann. Soc. d'Agric., Sci., Indus. Lyon, vol. 10, p. 623—"la Bolivie"; Amer. Mus. Nat. Hist.

The actual country of origin of the type of *philippii* has never been determined satisfactorily. Bourcier cited Bolivia, but Gould (1854, A monograph of the Trochilidae, text to pl. 21) remarked that he believed Bourcier to be unaware of the correct region and in 1861, in the "Introduction to the Trochilidae" (p. 43), gave the distribution as Perú or Bolivia without stating where he obtained the suggestion of Perú. Mulsant, Verreaux, and Verreaux (1866, Essai d'une classification méthodique des trochilidés, p. 18) and Bourcier and Mulsant (1874, Hist. Nat. Oiseaux-Mouches, vol. 1, p. 87) included both countries in the range. Salvin and Elliot (1873, Ibis, ser. 3, vol. 3, p. 13) discount Gould's Perú and accept Bourcier's Bolivia as does Berlepsch (1889, Jour. f. Ornith., vol.

37, p. 100). Bond and deSchauensee (1943, Proc. Acad. Nat. Sci. Philadelphia, vol. 95, p. 200) conclude that the species was described from eastern Bolivia but had no Bolivian material; Gyldenstolpe (1945, K. Svenska Vetensk. Akad. Handl., vol. 22, no. 3, p. 74), recording specimens from the Rio Juruá, Brazil, accepts "Upper Amazonia" which is somewhat generalized but closer to the mark than "Bolivia" where the bird is not known to occur.

Gould's assumption of Perú as a possible country of origin is now justified. I have before me four examples from northeastern Perú, three from the south bank of the Amazon, and one from the right bank of the upper Río Ucayali. These localities fit very well with the antecedent records from western Brazil, south of the Amazon, ranging from São Paulo de Olivença to the right bank of the Rio Madeira, a fairly compact area. If the type of *philippii* actually came from Bolivia, it almost certainly must have come from the extreme northern (not eastern) part of the country, although it has never been taken anywhere with certainty within Bolivian boundaries.

To make matters more complicated, the type is clearly labeled "Peru," although it is not certain who wrote the locality on the label. Judging by the styles of handwriting and the crossing of the lines in one place, the small tag that serves for a label was first inscribed: "Type/Dephilippi." Subsequently the generic name "Phaethornis" was added above the specific name, and below it "Peru" and "Bourcier" were written on separate lines. I judge the original inscription was by Bourcier himself, and the generic name may possibly have been added later by him, although he described the species as a *Trochilus*. The words "Peru" and "Bourcier" are in Elliot's handwriting, agreeing with similar inscriptions on other birds from the Elliot Collection. It is strange that he should have given the locality as Perú since in his "Classification and synopsis of the Trochilidae" (1879, Smithsonian Contrib. to Knowledge, no. 317, p. 13) he cites the locality as Bolivia, although the type was by that time in his possession!

The type is more deeply rufescent below and on the tips of the lateral rectrices than any of the 21 other specimens I have of the species, and also has the uropygial feathering more broadly and deeply rufescent at the tips. Some of this may be due to immaturity, of which there are slight suggestions, although the deeper coloration may be the result of post-mortem change. The nearest

approach in most of the characters mentioned is to be seen in a specimen from Orosa, Perú, although a Teffé bird is a little deeper in color on the anterior under parts, not so dark as the type. The series of fresh specimens is too uniform to suggest any subspecific distinctions.

I have omitted the published synonymy of the various references to this bird that consist mostly of emendations of spelling of the specific name as "*Filippi*," "*de Filippii*," "*Philippi*," etc., including "*Dephilippi*" on the label of the type, as mentioned above.

SPECIMENS EXAMINED

P. philippii.—

PERÚ:

- Orosa, 3 ♂;
- Lagarto, Río Ucayali, 1 ♀.

BRAZIL:

- Teffé, 3 ♂, 6 ♀;
- Rio Madeira, Borba, 1 ♂;
- Alliança, 1 ♀;
- Calamá, 1 ♀;
- Humaythá, 1 ♀;
- Igarapé Auará, 1 (?);
- Rio Machados, Jamarysinho, 1 (?).

***Phaethornis ruber nigrinctus* Lawrence**

?*Trochilus Adolphei* LESSON, 1843 (Oct. 22), *Echo du monde savant*, vol. 10, no. 32, col. 756—Acapulco.

Phaethornis nigrinctus LAWRENCE, 1858, *Ann. Lyc. Nat. Hist. New York*, vol. 6, p. 260—Ecuador [type from Río Napo]; [♂]; *Amer. Mus. Nat. Hist.*

This little bird, apparently the smallest form in the genus *Phaethornis*, has a fairly wide distribution from the Casiquiare region of southern Venezuela to northern Perú, south of the Marañón, including the lower Río Ucayali. It most nearly resembles *P. r. episcopus* of British Guiana and the Orinoco and Caura valleys, which reaches the neighborhood of Mt. Duida and the upper Casiquiare and appears again near the mouth of the Río Negro at Manaos, possibly reaching this latter area by extension from British Guiana since connection with the Orinoco seems to be blocked by the interposition of *nigrinctus*.

The differences from *episcopus* are well marked. In addition to the smaller dimensions of *nigrinctus*, this latter form has the back, and the top of the head also in the adult males, dark green

without the bronzy hue of *episcopus* (and *r. ruber*), while the females may have a more bronzy tone approaching that of *episcopus*; the maxilla is lighter and more brownish than blackish, and the mandible is pale nearly or quite to the tip, being a little more extensively shaded in the females examined than in the males; the rufous patch on the uropygium is a little more restricted, equally sharply defined in the males, and in the females more restricted than in the same sex of *episcopus*. The rectrices of the adult males have the same coppery tone and blackish margins or dusky subterminal area as are found in *episcopus* in contrast to the lighter and more evenly colored tail of *ruber*. The tails of the females of the two forms are similar (except in length) and not always distinguishable from the tail of *ruber*, although they reach a darker extreme, with pronounced marginal and subterminal blackish markings.

Friedmann (1948, Proc. U. S. Natl. Mus., vol. 97, p. 420) recorded *episcopus* from three localities on the Casiquiare, in Venezuela, and one from the Orinoco. Through his kindness I have been enabled to examine these specimens and have found that the examples from the upper Casiquiare and the Orinoco are certainly *episcopus*, while those from near the mouth of that waterway belong to *nigricinctus* as does a specimen in the American Museum collection from that same area. The National Museum specimens are, as Friedmann remarked, in poor condition, but measurements and such details of coloration as can be observed make their identification possible. Apparently, therefore, both *episcopus* and *nigricinctus* occur on the Casiquiare although not in the same restricted areas.

An error of long standing concerns four specimens from San Agustín, eastern Bolivia, recorded by Hartert (1897, Ibis, ser. 7, vol. 3, p. 429) as *nigricinctus*. These four birds are before me and unquestionably are not *nigricinctus*. Bond and deSchauensee (1943, Proc. Acad. Nat. Sci. Philadelphia, vol. 95, p. 201) similarly identified nine Bolivian specimens as this form. Through their kindness I have examined these examples and find them exactly like the four San Agustín birds. In addition, five specimens from the Rio Madeira and four from Teffé fit well into this series. Just what these should be called is not perfectly clear. They agree very closely with *P. r. ruber* and such distinctions as they show are not very satisfying, being overcome by the individual variation of *ruber*. These distinctions consist of a somewhat

shorter dusky tip on the mandible and a greener back on an average. In the southwestern population, the dark tip of the mandible ranges from 6 to 9 mm. in length, averaging 7.5; in the rest of the series of *ruber* it ranges from 7.7 to 12.5, averaging 9.6. Unfortunately seven of the 17 southwestern birds have this tip within the limits of the rest of the series in which 13 of 29 examples measured have the marking as short as is shown by some of the southwestern series. This distinction is thus of limited value. Likewise the dorsal coloration is not a safe criterion, although the trend is noticeable. Consequently I believe it is best to refer these Bolivian and southwest-Brazilian specimens to typical *ruber*. The tendency toward a shortening of the dark tip of the mandible and a darker green back probably reflects an approach toward *nigricinctus* in which both details are carried to a greater extreme together with a reduction in size not shown by the Bolivian and Brazilian birds.

A single female from the lower Ucayali, in Perú, on the other hand, is *nigricinctus*, the only example I have from south of the Amazon. Other records that presumably belong here are from Nauta, Chayavitas, Chamicuros, Jeberos, Yurimaguas, and "Upper Amazons."

I am not sure that the name *adolpher* is not applicable to the present form. Simon (1921, *Histoire naturelle des Trochilidae*, p. 262) includes a reference to Lesson's description and name in the synonymy of "*pygmaea*" [= *ruber*], with a note to the effect that the account must refer to "*pygmaea*" because of the mention of the black chest-band that occurs in that form. Unfortunately for this definite allocation, the band is even more pronounced in *episcopus* and *nigricinctus* than in *ruber* where, however, it does occur, and slight disarrangement of the pectoral feathering of various other species often gives a false impression of similar marking. Furthermore, Lesson describes the bill as black above and white below, which is inaccurate for any of the three forms mentioned, unless the "blanc en dessous" be taken to indicate a mandible without any terminal dark area as it is in some *nigricinctus*. The back is said to be dark green, with no mention made of the bronzy reflections found in *ruber* and *episcopus*. The graduated tail with rufescent margins (?tips) is not distinctive, nor is the rufescent lower surface of the body. "Acapulco" is, of course, an error, as pointed out by Simon, although it gives no clue as to the possible correct locality.

Lesson's entire diagnosis is very brief, being quite at variance with the detailed descriptions he customarily provided. No mention is made, for instance, of the facial pattern or of the rufous uropygial patch, both of which are conspicuous features of these birds. The paper in which the account appears is, in fact, a mere summary of the species which the author planned for a supplementary fourth volume of his "Histoire naturelle" of the hummingbirds—a volume that was never published although 100 plates were said to have been prepared for it. "*Trochilus Adolphei*" was to be figured on plate 24. If this "manuscript" plate is still in existence, it might be possible to determine precisely to which form the name properly applies. There is enough uncertainty at present to make me unwilling to supplant the name *nigricinctus*, whose application is unquestionable, by *adolphei*, which is still in doubt.

***Phaethornis stuarti longipennis* Berlepsch and Stolzmann**

Phaethornis rufigaster longipennis BERLEPSCH AND STOLZMANN, 1902, Proc. Zool. Soc. London, vol. 2, p. 19—Chanchamayo, Perú = La Merced; ♀; Warsaw Mus.

This form was described as identical with Brazilian "*rufigaster*" [= *ruber*] except for longer wing—41.5 and 43.75 mm. (elsewhere in the account, 42.75). Simon (1921, Histoire naturelle des Trochilidae, p. 21, footnote) notes two central-Peruvian birds as like "*pygmaea*" [*ruber*] but larger, with wing 39 mm. *P. stuarti* of Bolivia, which has a wing of somewhat the same length, is at once suggested, although Berlepsch and Stolzmann note that the median rectrices of *longipennis* are tipped with rufous, not white as in *stuarti*; Simon states that in one of his two birds, the median rectrices are reddish bronze as in *P. r. episcopus*, and adds an additional character of uncertain value—the black ocular band broader anteriorly than in "*pygmaeus*" [*ruber*]. The latter feature is found also in *stuarti*, but the reddish bronze median rectrices I have not observed in this form to a degree comparable with *episcopus*.

To make matters more confusing, Tschudi (1844, Fauna Peruana, Aves, p. 243) describes as "*pigmaeus*" (*pygmaeus* on other pages) one or more specimens (unquestionably from central Perú) as having white tips on all the rectrices except the outermost where they are buffy ("falb"); the tail is said to be colored like the back; wing, "1'' 7'''" (in "Old Prussian" = 41.4 mm.);

superciliaries white (as in *stuarti* but not in *r. ruber*). I cannot find any reference to Tschudi's record in subsequent papers by workers in this group. No one seems to have succeeded in identifying it or to have taken the trouble to comment on it. His description agrees well with some examples of *stuarti*, but does not accord with *ruber* which Berlepsch and Stolzmann say their *longipennis* duplicates in all but size. Tschudi gives the length of bill as 12 lines, which in "Old Prussian" measurements equals 26.1 mm., a length that is more than Berlepsch and Stolzmann cite for *longipennis* (21.75–20.75 mm.) and equaled, in other central Peruvian forms that might enter the present discussion, only by *P. longuemarea atrimentalis*. This last-named bird has white superciliaries, white-tipped rectrices, long wing and tail, and long bill, but does not have the uniformly colored under parts Tschudi describes.

Mr. deSchauensee of the Academy of Natural Sciences of Philadelphia has kindly lent me a specimen from southeastern Perú, identified as *longipennis*, which throws considerable light on this puzzling problem. Although this specimen differs in minor details from the accounts of both Tschudi and Berlepsch and Stolzmann, it tends to combine the essential points of both and to indicate the probability that a single form is involved with a certain amount of individual variation sufficient to cover the discrepancies in the two descriptions. The bird is sexed as a male but, judging by certain details of tail structure, noted in many species of the genus, presumably is a female or a young male.

The bird in hand bears a certain resemblance to *P. r. ruber* but has the mantle greener, less bronzy, the black malar stripe broader beneath the orbit, the entire under parts lighter and duller, less rufescent, the superciliaries more whitish, the blackish area in the center of the breast small and with pale buffy tips on the feathers, and the wing, tail, and bill longer. In these respects it may be matched quite closely with some specimens of *stuarti* and not with any of the series of *ruber* examined.

The tail offers further evidence of affinity to *stuarti*, and it is in respect to this member that Tschudi's account disagrees with that of Berlepsch and Stolzmann. The general color of the rectrices, particularly the median ones, is lighter green than the back but darker than in most *r. ruber* in comparable plumage. The median feathers are narrowly tipped with white and have a small patch

of buff on the outer web extending a little basad from the white tip. The second and third pairs of rectrices have rather broad ($\frac{1}{4}$ mm. at shaft) cinnamomeous tips, with a touch of whitish at the extreme apex of the second pair, and while the bright area is a little longer on the outer margin than on the inner one, its proximal border is relatively straight and there is no sharp discontinuity at the shaft with a pronounced basad extension on the outer web such as occurs in *ruber*. The two outer pairs of rectrices are also rufous tipped, with a stronger basad extension of the color along the outer margin.

Stuarti males, of course, have the tail-feathers, at least the median two or three pairs, broadly tipped with white. Females, however, may have the tips of the median pair white but those of the remaining pairs rufescent, sometimes with a trace of white on the submedian pair. The demarcation between the dark base and bright tip is, at least in some specimens, of the pattern described in the preceding paragraph for the Peruvian specimen. In fact, one female of *stuarti* is very like the Peruvian specimen, except that the white tips on the median rectrices are twice as long. This resemblance includes the general coloration, as well as the tail characters, although the Peruvian specimen is a little darker in tone.

The affinity of the Peruvian specimen to *stuarti* rather than to *ruber* is thus unquestionable. It is not topotypical and hence may differ slightly from central-Peruvian specimens, of which unfortunately none is available for study. Berlepsch and Stolzmann, as noted above, describe the tips of the median rectrices as rufous, not white, and perhaps this may be true for topotypical females, including the type. The southeast-Peruvian bird (?female) is exactly intermediate in this character between the type of *longipennis* (as described) and the nearest approach in *stuarti*. No other positive difference is apparent. Tschudi's account rather certainly concerns the male plumage and shows no character that gives a clue to distinction from males of *stuarti*. Such distinction, if it exists, must await exact comparison by someone with males of both for comparison. In the meantime, *longipennis* may, I believe, be safely transferred to conspecific status with *stuarti*.

Records are from La Merced and Borgoña. Tschudi's exact locality was not specified but is certain to be in the same general region.

SPECIMENS EXAMINED

P. r. ruber.—

SURINAM:

Near Paramaribo, 1 ♂.

CAYENNE:

Tortue, Approuague River, 1 ♀ ;

Cayenne, 1 ♂, 1 ♂¹, 1 (?)¹.

BRAZIL:

Faro, 1 ♀ ;

Pará, 1 (?) ;

Prata, Pará, 5 ♂, 1 ♀ ;

Goiaz (Goiaz and Rio Uruhu), 1 ♂, 1 (?) ;

Bahia (Bahia, Bôa Nova, Cajazeiras, and Baixão), 8 ♂, 3 (?) ;

Rio de Janeiro, 4 (?) ;

Rio Tocantins, Mocajuba, 1 (?) ;

Rio Tapajoz (Santarem, Itaituba, Igarapé Amorin, and Caxiricatuba), 1 ♂, 3 ♀ ;

Teodoro River, 1 ♂ ;

Rio Madeira (Humaythá, Calamá, and Rosarinho), 1 ♂, 2 ♀, 1 (?) ;

Teffé, 2 ♂, 2 (?) ;

"Brazil," 1 ♀, 3 (?) .

BOLIVIA:

San Agustín, 3 [♂], 1 (?) ;

Chañiri, Río Kaka, 1 ♂¹, 1 ♀¹ ;Susi, Río Beni, 1 ♂¹ ;Santa Ana, Río Coroico, 2 ♀¹ ;Huanay, Río Mapiri, 1 ♂¹, 2 ♀¹ ;Teoponte, Río Kaka, 1 ♀¹.*P. r. episcopus*.—

BRITISH GUIANA:

Annai, 1 ♂ ;

Potaro Landing, 1 ♂ ;

Kamakusa, 1 (?) ;

Demerara, 1 [♂], 1 [♀].

VENEZUELA:

Mt. Auyan-tepui, 1 ♀ ;

Suapure ("mountains"), 3 ♂, 1 ♀ ;

Nericagua, 1 ♂, 1 ♀ ;

Munduapo, 3 ♂, 2 ♀ ;

La Prisión, Caura, 1 ♂ ;

Boca de Sina, 1 (?) ;

Lalaja, Río Orinoco, 1 ♂, 2 ♀ ;

Puerto Ayacucho, 1 ♂² ;

Mt. Duida (Esmeralda, Playa del Río Base, Pie del Cerro, Caño Seco, Campamento del Medio, and Savana Grande), 3 ♂, 5 ♀ ;

Brazo Casiquiare, below mouth of Río Paciba, 1 ♂², 1 (?)².¹ Specimens in Academy of Natural Sciences of Philadelphia.² Specimens in United States National Museum.

BRAZIL:

Manaos, 3 ♂, 2 ♀.

P. r. nigricinctus.—

VENEZUELA:

Buena Vista, Casiquiare, 1 ♀;

Chapazon, 1 (?)¹;

Cerro Guanari, 1 ♀¹.

COLOMBIA:

Río Uaupés, opposite Tahuapunto, Brazil, 1 ♀

BRAZIL:

Rio Negro, Cucuhy, 2 ♂, 2 ♀.

ECUADOR:

"Napo," 1 [♂] (type).

PERÚ:

Pebas, 1 [♂], 1 (?);

Sarayacu, Río Ucayali, 1 ♀.

P. s. stuarti.—

BOLIVIA:

Salinas, Beni, 5 (?) (including type);

Mission San Antonio, 1 ♂;

Tres Arroyos, 1 ♂;

Todos Santos, 1 ♂, 1 "♀" [?= ♂];

mouth of Río San Antonio, 2 ♀;

Province of Sara, 3 ♂, 1 ♀.

P. s. longipennis.—

PERÚ:

La Pampa, Sandia, 1 "♂"².

***Phaethornis griseogularis griseogularis* Gould**

Phaethornis griseogularis GOULD, 1851 (Nov.), A monograph of the Trochilidae pt. 2, pl. [14] and text [= vol. 1, pl. 30 of completed work]—Bogotá and Quito; Bogotá skins in British Mus. considered as "types" [= cotypes].

Trochilus Aspasiae BOURCIER AND MULSANT, 1856, Ann. Soc. Linnéenne Lyon, new ser., vol. 3, p. 188—"Nouvelle Grenade"; [♀]; Amer. Mus. Nat. Hist.

A good series of specimens ranging from eastern Colombia to the eastern face of the Andes of northern Perú is relatively uniform in characters.

Unless there has been incorrect sexing of many of the specimens of the series (the Bogotá trade-skins, of course, are not sexed), I am unable to get a clear picture of the sexual distinctions in this species. Two types of presumably adult plumage are exhibited in the series. In one of these, the submedian rectrices are shorter than the median pair by an amount rather less than the difference between the submedian and third pair; sometimes median and

¹ Specimens in United States National Museum

² Specimen in Academy of Natural Sciences of Philadelphia.

submedian are subequal. There is some development of white at the tips of the submedian feathers and a trace of it sometimes on the third pair, especially on the inner web. The under parts are relatively deeply rufescent, with the chin showing an ill-defined dusky area and the breast often duller rufous than the lower under parts. The rufous feathers of the uropygium are deeply colored and usually show definitely greenish centers, sometimes strongly developed. Birds of this nature include some sexed as males but none sexed as females, and I believe this is the adult male plumage, judging by the sexual distinctions shown by certain other species of the genus.

The other type of plumage shows considerable elongation of the median rectrices beyond the adjacent pair. The tips of the median feathers are white, but those of the submedian pair are rarely more than buff and often as strongly ochraceous as the tips of the outer three pairs. The under parts average a little lighter in color than in the other type of plumage; the chin is often whitish; the rufous uropygial area shows less development of the green central spots on the feathers. Birds of this sort include examples sexed as females and others sexed as males. I suspect that the plumage is that of the adult females, although young males may wear it for an undetermined period. Curiously, of 28 Bogotá skins, 22 show this sort of plumage, and only six are in the other dress.

There appear to be no earlier Peruvian records of certain assignment to true *griseogularis*. Specimens from Callacate presumably belong to the form next to be discussed, and a specimen from "Perú" recorded by Elliot and now before me is almost certainly a Bogotá trade-skin in the "female" plumage; the type of "*Aspasiae*" is of exactly comparable nature.

The specimen from Florencia, Colombia, recorded by Chapman (1917, Bull. Amer. Mus. Nat. Hist., vol. 36, p. 283) as *griseogularis* belongs to *P. longuemareus atrimentalis*.

***Phaethornis griseogularis zonura* Gould**

Phaethornis zonura GOULD, 1860, Proc. Zool. Soc. London, pt. 28, p. 305—Perú; I suggest Santa Rosa, middle Marañón Valley, British Mus.

Phaethornis aphaeles HEINE, 1884, Jour. f. Ornith., vol. 32, p. 235—Perú; I suggest Santa Rosa, middle Marañón Valley; Halberstadt Mus.

It is with considerable trepidation that I identify Gould's and Heine's birds with five specimens now before me from the middle Marañón region of northern Perú. Neither original description

agrees in all details with the birds at hand nor do they agree in all details among themselves, but it is impossible to assign them to *P. griseogularis* or to *P. porcellae*, to each of which they show some resemblances as well as some differences. Both Gould and Heine were convinced that they had a bird distinct from *griseogularis* (*porcellae* was not then known), although later authors have not been so certain. The names *zonura* and *apheles* have been moved around in curious fashion, as is shown below.

Salvin and Elliot (1873, *Ibis*, ser. 3, vol. 3, p. 273) examined the type of *zonura* which they considered identical in all particulars with *griseogularis*.

Heine (*loc. cit.*) does not mention *zonura* but says that *apheles* had long been confused with *griseogularis*, proceeding then to compare his bird with "*adolphi*" (Bourcier) without stating how it differs from *griseogularis*.

Berlepsch (1887, *Ibis*, ser. 5, vol. 5, p. 291), after examination of the type of *apheles*, discusses it in comparison with *P. nattereri* which he described on an earlier page.

Hartert (1892, Catalogue of the birds in the British Museum, vol. 16, p. 281) places *zonura* in the synonymy of *griseogularis* but omits any mention of *apheles*. Later (1900, *Das Tierreich*, no. 9, Trochilidae, p. 24) he continues to subordinate *zonura* under *griseogularis* and at the same time (p. 26) recognizes *apheles* as a distinct species.

Simon (1921, *Histoire naturelle des Trochilidae*, p. 261) recognizes *zonura* as a distinct species and places *apheles* under it with a query.

Peters (1945, Check-list of birds of the world, vol. 5, p. 16) follows Simon's treatment.

Gould compares his *zonura* to *griseogularis* and notes the larger size of *zonura*; the strongly contrasted black basal portion of the tail with the central rectrices broadly tipped with white (no mention of the gray subterminal area he describes for *griseogularis*); white on the inner web of the tip of the submedian rectrices, buff on the inner web; under parts buff with the chin whitish; basal half of the mandible yellow (basal two-thirds noted for *griseogularis*); wing, $1\frac{3}{4}$ inches; tail, $1\frac{5}{8}$; bill, 1. The measurements are somewhat greater than are shown by any of the birds I have assigned to *zonura*, but, being in inches and large fractions, are rather too generalized for complete accuracy. In any case, I have been able to secure more serviceable data.

Captain Jean Delacour, on a recent visit to London, very kindly examined the type of *zonura* in comparison with the type of *griseogularis* and other specimens of the latter form, and confirmed my suspicions concerning the identity of *zonura*. He found the bill to be broken and lacking the terminal third of the maxilla, possibly accounting for Gould's failure to comment on the degree of curvature; the tips of the median rectrices are clear white, without a grayish or brownish subterminal band; the under parts are lighter than in *griseogularis*; the yellow basal portion of the mandible is shorter than in the type of *griseogularis*—less than one-half of the total length in both cases; wing, 40 mm.; tail, 39; bill, ? These figures agree well with the measurements of the birds now before me.

One important detail that Gould does not mention is the curvature of the bill, and his plate in his monograph does not give any indication of difference from *griseogularis* in this respect. Actually, the five birds now before me have the bill distinctly more curved than any *griseogularis* I have examined, agreeing in this particular with *porcellae*. The yellow basal portion of the mandible varies from about one-third to one-half of the length of this member, while in *griseogularis* it varies from one-half to three-fifths. The white tip of the median rectrices sometimes is preceded by a gray subterminal band or by a gradual development of a grayish tinge, usually not clearly defined from the white apex. The white tips on the submedian rectrices are broad and may be without any trace of ochraceous color, while the third pair in the majority of the series has noticeable white at the apex, although most of the tip is pale ochraceous. The superciliary stripe is whitish, with a slight tinge of ochraceous posteriorly, without the richer coloration shown by *griseogularis*. The under parts of the body are paler ochraceous than in *griseogularis* and in one example from Cabico, Río Chamaya, closely approximate the appearance of *porcellae*, although the back is not so dark green and the outer tail-feathers are not sufficiently white to allow the bird in question to be referred to the more western form.

Heine's description of *apheles* presumably concerns a different example of the same form as Gould's type, although his description gives nothing by way of comparison to *griseogularis* but only to Bourcier's "*adolphi*," while Berlepsch's comments on the type refer only to *nattereri*. Nevertheless, *apheles* would appear to have been based on a bird with measurements much like those of

the type of *zonura* (wing, 41; tail, 45; culmen, 23), with prominent white tips on the median rectrices and noticeable white on the apices of the otherwise rufous tips of the submedian feathers; the remaining rectrices are rufous tipped; throat and mid-belly whitish (perhaps as in the Cabico bird mentioned above).

Through the kindness of Dr. Karl P. Schmidt and Mr. Emmet R. Blake of the Chicago Natural History Museum I have been able to consult a transcript of notes on the type of *apheles* made by Count Berlepsch and preserved by C. E. Hellmayr. Berlepsch gives a more complete description of the type than was supplied by Heine, although he again compares it to the Matto Grosso bird (obviously *nattereri*) with additional comparison to *longuemareus* from which he says it differs by the long ochraceous tips on the outer rectrices and the rusty white throat. His measurements are slightly different from those of Heine: wing, 42.5 mm.; tail, 42; culmen (defective), 22.5. There is again no reference whatever to *griseogularis*! However, the description of the tail may be matched in the series at hand except for the complete length which is greater than in any of the five birds. Berlepsch describes the tail as golden bronze at the base: median rectrices with a median black area 11 mm. wide; tip white with a light brownish white area between it and the black space; submedian feathers rufous brown on outer web and tips of both webs white; other rectrices with rufescent tips without white admixture. Median feathers 42 mm. in length; submedian, 32; outermost, 20. (The lengths of submedian and external feathers agree with the limits of *zonura* as here identified but are outside those of *griseogularis*.) Upper tail-coverts green, with narrow, dull rufous terminal margins (but specimen here defective). (The shorter upper tail-coverts of some of the birds at hand show this feature, which is well-developed in *porcullae*.) A light brownish white tinge in the subterminal portion of the median rectrices, between the black basal area and the white tip, is suggested in part of the present material.

Both Gould's and Heine's specimens were collected by Warszewicz, and while I have not been able to determine his Peruvian itinerary with any certainty, it is fairly evident that he was in the region of the middle Marañón—the area covered by the birds I have identified as *zonura*. *Lepidocolaptes lacrymiger warszewiczi*, for example, was named for him from material he collected and is

confined to this area (see Zimmer, 1934, Amer. Mus. Novitates, no. 753, p. 22).

Two birds from the Moyobamba region have their bills somewhat more strongly arcuate than the great majority of *griseogularis*, and one of them has the yellow of the basal portion of the mandible relatively restricted as in *zonura*, but the appearance of the tail is exactly as in *griseogularis* females, although one of the two birds is sexed as a male with enlarged gonads; the other is non-sexed. Since two males of *griseogularis* are at hand from the upper Huayabamba Valley, not far from Moyobamba and on the same eastern face of the Andes, it seems unlikely that the Moyobamba specimens (Uchco and Río Seco) belong to *zonura*. On the character of the bill, and the coloration of the under parts, they are intermediate between *zonura* and *griseogularis*. On the other hand, *zonura* is intermediate between *griseogularis* and *porcullae*. At first glance, *porcullae* appears to stand well apart from *griseogularis*, but *zonura* forms a bridge. The dorsum resembles that of *griseogularis* at its darker extreme; the under parts are lighter than those of *griseogularis* and sometimes show a close approximation of those of *porcullae*; the coloration and length of the tail are exactly intermediate, with more white than occurs in *griseogularis* and more rufescence than in *porcullae*; the bill is greatly curved as in *porcullae* though no longer than in *griseogularis*. It may be noted that the specimen that shows the closest approach to *porcullae* is the bird already mentioned from Cabico, a locality just east of Porculla Pass.

The measurements of the three presumed subspecies are difficult to present owing to the uncertainty of sexing (or lack of it) in much of the material at hand. This is unfortunate in respect to the tail, since females and apparently young males have a longer tail than the adult males. Wing and bill are not so obviously different. Regardless of sex, however, *griseogularis* has the wing 33–41 mm. (average, 33.6); tail, 29.5–38.5 (34.4); culmen, 20–23 (21.0). *Zonura*: wing, 38–42 (40.2); tail, 36–39 (37.9); culmen, 20–23 (21.6). (Including Heine's figures, *zonura* shows 38–42, 36–45, and 20–23, respectively.) *Porcullae* (including Carriker's figures for the type): wing, 40–44 (42.4); tail, 37–46 (41.8); culmen, 23.5–25 (24.4).

Obviously a larger series of middle Marañón birds would be highly desirable to determine the full extent of individual variation both in size and coloration, but the few examples now at

hand indicate the distinction of the population as well as its intermediate position sufficiently well to recommend the arrangement I have adopted.

Three specimens collected by Stolzmann at Callacate appeared of probable reference to *zonura*. One of these, in the British Museum, also was examined by Captain Delacour who advised me that it showed the bill distinctly more strongly curved than that of *griseogularis*; clear white tips on the median rectrices; under parts even duller than in the type of *zonura*; wing, 37 mm.; tail, 33; culmen, 22. The measurements of wing and tail are slightly smaller than any others I have for *zonura*, but the other characters and the geographical position of the locality point so strongly to assignment here that I think there can be no question of it.

Except for the Callacate birds and the types of *zonura* and *apheles*, there are no other recorded specimens of probable assignment to this form.

Phaethornis griseogularis porcellae Carriker

Phaethornis porcellae CARRIKER, 1935 (Oct. 25), Proc. Acad. Nat. Sci. Philadelphia, vol. 87, p. 345—Porculla Pass, Dept. Lambayeque, Perú; ♀; Acad. Nat. Sci. Philadelphia.

Three males and one non-sexed bird from Palambla belong to this western form which I believe must be considered as a subspecies of *griseogularis* for reasons discussed under *P. g. zonura*. It is well marked, with strongly curved bill, dark green (but not bronzy) back, sooty brown cap, whitish superciliaries, pale under parts, reduced rufescent area on the uropygium, almost entirely white tips on all the rectrices, and longer wing, tail, and bill, on average, than either *griseogularis* or *zonura*. All four birds have the rufous uropygial feathers with more extensive green central areas than are shown by the other forms, although there is some development of the character in undoubted males of *griseogularis* and it is suggested in *zonura*—perhaps equally well developed as described for "*apheles*." The yellow at the base of the mandible occupies less than half of the length of that member. The gray subterminal area on the median rectrices varies from a short triangular space on the inner web in one example to a fairly well-defined band as in *griseogularis*. The superciliary stripe is white or light buffy.

There are no earlier records assignable to *porcellae* except those

of the original description, the type and one paratype from Porculla Pass.

SPECIMENS EXAMINED

P. g. griseogularis.—

COLOMBIA:

Mt. Macarena, 1 [♂], 1 [♀];

"Bogotá," 29 (?) (including type of "*Aspasiae*").

ECUADOR:

Río Suno, above Avila, 1 ♀;

below San José, 3 "♂";

Zamora, 4 [♂].

PERÚ:

Andoas, 1 "♂" [= ♀],

Uchco, 1 "♂";

Río Seco, 1 [♀];

Huayabamba [Valley], 2 ♂.

P. g. zonura.—

PERÚ:

San Ignacio, 1 [? ♂];

Santa Rosa, 1 "♀," 2 (?);

Cabico, 1 ♀.

P. g. porcullae.—

PERÚ:

Palambra, 3 ♂, 1 (?).

Phaethornis longuemareus atrimentalis Lawrence

Phaethornis atrimentalis LAWRENCE, 1858, Ann. Lyc. Nat. Hist. New York, vol. 6, p. 260—Ecuador = Napo; [♂]; Amer. Mus. Nat. Hist.

Phaethornis riojae BERLEPSCII, 1889, Ibis, ser. 6, vol. 1, p. 182—Rioja, Perú; ♂; Frankfort Mus.

I have already (1930, Field Mus. Nat. Hist., zool. ser., vol. 17, p. 273) commented on the identity of *riojae*, from information supplied by the late C. E. Hellmayr. There is little to add here. Seventeen birds from eastern Ecuador and northern Perú are relatively uniform within limits of variation apparently due to sex and age, of which further mention is made in the discussion of the following form.

Additional records (as *atrimentalis*, *striigularis*, and *riojae*) are from Rioja, Chayavitas, and Nuevo Loreto (Palma). It is possible that the type was collected on a portion of the Río Napo now in Peruvian territory, but there is no assurance of it.

Among the specimens examined for comparison with the present form are two from a new locality for the species, the right bank of the Rio Tapajoz, Brazil. They present certain marked dis-

tinctions from *atrimentalis* to which, however, they bear more resemblance than to any other conspecies, and deserve separate recognition as follows.

***Phaethornis longuemareus aethopyga*, new subspecies**

TYPE: From Caxiricatuba, Rio Tapajoz (right bank), Brazil. No. 2859+9, American Museum of Natural History. Male (possibly adult), collected May 20, 1931, by Alfonso M. Olalla.

DIAGNOSIS: Most nearly resembling *P. l. atrimentalis* of eastern Ecuador and Perú, but with uropygium more strongly and clearly rufescent; subterminal area of median and submedian rectrices brownish rufous instead of gray; outer margins of rectrices at base strongly white or gray; point of chin white; gular area more broadly black (in male), nearly obliterating the pale malar stripe which is more rufescent than in *atrimentalis*; under parts (in male) more deeply rufescent, including the under tail-coverts; dark pectoral band virtually obsolete; dark tip of mandible shorter.

RANGE: KNOWN only from the type locality.

DESCRIPTION OF TYPE: Back glossy Hellebore Green, carried forward over the head but becoming duller and changing to brown on the forehead; rump similar with bright rufescent margins; upper tail-coverts clear Sanford's Brown with central shaft streaks of green barely suggested. Lores brown; narrow subocular line and auriculars blackish, separated from the cap by a white superciliary stripe not reaching forward beyond the mid-point of the orbit; point of chin white; upper throat broadly black, almost in contact with the black of the auriculars but separated by a weak malar stripe, white anteriorly, rufous posteriorly; chest dull Cinnamon-Rufous, darkening on sides of neck to Hazel; upper breast Sanford's Brown $\times$ Burnt Sienna, changing to light Cinnamon-Rufous on belly and deepening again on the under tail-coverts. Remiges and greater upper wing-coverts Dusky Drab, with traces of fine, pale tips on a few of the inner coverts; rest of upper wing-coverts green; under wing-coverts deep Sanford's Brown. Tail graduated; rectrices, except outermost pair, with a strong white area at base of outer web and on inner web also of median pair where the white mark nearly reaches the shaft and extends as far as the tips of the upper tail-coverts; remainder of median pair (to near tip) dark brown with a greenish sheen, followed by a subterminal band of Hazel, and broad white tip;

submedian pair similar but basal portion with little greenish sheen and white tips reduced; rest of rectrices similar with white tips only faintly suggested. Maxilla (in dried skin) black; mandible largely dull yellowish with a short (5-8 mm.), poorly defined brownish tip; feet yellowish with black claws. Wing, 42.5 mm.; tail, 35; culmen, 25.

REMARKS: A second specimen from the same locality is not sexed but differs from the type in much the same way that females of *atrimentalis* differ from males of that form, being paler in ventral coloration and with the dark gular area reduced to dusky-centered feathers edged with light ochraceous. The point of the chin remains white (slightly suggested in a single female of *atrimentalis*) and the under tail-coverts are ochraceous like the belly. The tail markings are like those of the type, except that the white basal area of the male is replaced by gray. I judge, therefore, that this second example is a female.

The dark pectoral band or blotch present in *atrimentalis* males is not pronounced in *aethopyga*, since the light-colored tips of the feathers in question are brown rather than blackish and the terminal margins are broader.

It has become evident in the study of *Phaethornis* that there may be a series of plumages between immaturity and full adulthood in many, if not all, of the species. In some of the species there is a notable difference between the tails of females and adult males. In the females, the central rectrices will be elongate and broadly tipped with white and at least the three outer pairs of feathers will be broadly tipped with rufous, while in the males the median and submedian feathers may be nearly equal in length and the terminal margins of all the rectrices narrow and white. When the available series of such forms is even moderately large, specimens can be found that show the tail in various stages of intermediacy between that of the females and that of the adult males. Some of these intermediate specimens appear to be adult as far as texture of plumage, absence of bright edging on the back, glossy crown, and other such details indicate. There is opportunity for interesting aviary studies of this situation. The point of present concern is that the type of *aethopyga* appears to be of this intermediate nature, having the median rectrices as elongate as those of the probable female and not at all in form like those of fully adult *atrimentalis*, although the bird otherwise appears to be adult. In any case, among the females and "intermediate-stage" males of

atrimentalis there is no suggestion of the coloration of the tail exhibited by the two examples of *aethopyga*.

The length of the dusky tip on the mandible is an excellent character by itself. In *atrimentalis* this tip ranges from 12 to 16 mm. in length and is blacker than in *aethopyga* where it is duller and greatly reduced in length.

In the investigation of the synonymies of the present species it came to light that the name *adolphi* given by Gould (1857, A monograph of the Trochilidae, pt. 14, pl. [15] and text [vol. 1, pl. 35 of completed work]) to the bird from Córdoba, México, is preoccupied by *Trochilus Adolphei* Lesson, 1843. The identity of Lesson's bird is open to question (see account of *Phaethornis ruber nigrinictus*), but the priority is not and it becomes necessary to supply a new name for Gould's bird. Accordingly I propose *Phaethornis longuemareus cordobae* as a new name for *Phaethornis adolphi* Gould (*loc. cit.*). Although Gould's and Lesson's birds were named for different individuals (Adolphe Boucard and Adolphe Lesson, respectively), both specific names were based on the same given name and the difference in spelling falls under the provisions of Article 35 of the International Code of Zoological Nomenclature under which homonymy is established.

SPECIMENS EXAMINED

P. longuemareus cordobae.—

México:

Córdoba, 1 ♂, 1 ♀, 1 "♂" [= ♀];

México, 1 ♂.

P. l. saturatus.—

GUATEMALA:

(Secanquim and Vera Paz), 3 ♂, 1 (?).

NICARAGUA:

(Río Tuma, Tuma, Chontales, Volcán Chinandega, Volcán Viejo, Los Sabalos, Uluce, Muy Muy, and Río Coco), 8 ♂, 2 ♀.

COSTA RICA:

(Bonilla, Puerto Jiménez, Miravalles, Limón, Buenos Aires, Bebedero, Aquinares, Carrillo, Guapiles, Boruca, and "Costa Rica"), 8 ♂, 5 ♀, 1 (?).

PANAMÁ:

(Río Calovevora, Boqueron, Boquete, Bogava, El Villano, Almirante, Santa Fé, Gatun, [Lion Hill], and Brava Is.), 8 ♂, 7 ♀, 3 (?).

NO LOCALITY: 1 [♂].

P. l. subrufescens.—

PANAMÁ:

(Cape Garachiné, El Real, and Cituro), 1 ♀, 3 (?).

COLOMBIA:

(Barbacoas [including type], Cocal, Nóvita, and Nariño), 3 ♂, 1 ♀, 2 (?).

ECUADOR:

(Chimbo, Mindo, below Mindo, Esmeraldas, Lita, Duran, Bucay, Naranjal, Cachabí, and "w. coast"), 10 ♂, 5 ♀, 4 (?).

P. l. striigularis.—

COLOMBIA:

(Puerto Valdivia, near Honda, and "Bogotá" [including type of *amaura*]), 1 ♂, 3 ♀.

P. l. atrimentalis.—

COLOMBIA:

Florencia, 1 ♀.

ECUADOR:

(Napo [including type], Río Suno, and below San José), 2 ♂, 3 ♀, 7 (?).

PERÚ.

Mouth of Río Curaray, 1 (?);

Puerto Indiana, 1 ♀;

mouth of Río Cinipá, 1 ♀;

Chuchurras, 1 ♀;

Puerto Bermúdez, 1 ♀¹.

P. l. aethopyga.—

BRAZIL:

Rio Tapajoz, Caxiricatuba, 1 ♂ (type), 1 [♀].

P. l. idaliae.—

BRAZIL:

(Rio de Janeiro, and Espírito Santo [Lagôa Juparaná] and Baixo Guandú), 4 ♂, 3 ♀, 1 "♂" [?= ♀].

P. l. longuemareus.—

CAYENNE:

(Cayenne, Approuague, and Roche Marie), 9 ♂, 3 ♀, 3 (?).

SURINAM:

(Kwata and near Paramaribo), 6 ♂, 3 (?).

TRINIDAD:

(Carenage, Caparo, Savannah Grande, Heights of Aripo, and Princetown), 6 ♂, 4 ♀, 3 (?).

No LOCALITY: 3 (?).

P. l. ignobilis.—

VENEZUELA:

Las Quiguas, 2 ♀.

¹ Specimen in Chicago Natural History Museum.

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STUDIES OF PERUVIAN BIRDS. NO. 56 THE GENERA *EUTOXERES*, *CAMPYLOP-* *TERUS*, *EUPETOMENA*, AND *FLORISUGA*

BY JOHN T. ZIMMER

In the following studies, names of colors are capitalized when direct comparison has been made with Ridgway's "Color standards and color nomenclature."

***Eutoxeres aquila aquila* (Bourcier)**

Trochilus Aquila BOURCIER, 1847, Proc. Zool. Soc. London, pt. 15, p. 42—vicinity of Bogotá, Colombia.

Mouth of Río Curaray, 1 ♀.

This specimen is the first example of the present species to be taken in Perú. It agrees well with other specimens from eastern Colombia and eastern Ecuador, although it shows the minimum development of white at the tips of the rectrices with little basal extension of this mark. The dark basal coloration, however, extends well toward the tip of the feathers along the inner margin, presenting one feature of the characteristic pattern.

***Eutoxeres condamini condamini* (Bourcier)**

Tr[ochilus] Condamini BOURCIER, 1851, Compt. Rendus Acad. Sci., Paris, vol. 32, p. 187—Archidona, Ecuador, Amer. Mus. Nat. Hist.

E[utoxeres] La Condaminei SIMON, 1921, Histoire naturelle des Trochilidae, pp. 24, 263—*nom. emend.*

The typical form of the species reaches the north bank of the Marañón as well as the mouth of the Curaray, both in Peruvian territory, and thus may be added to the Peruvian list. The two Peruvian specimens available are inseparable from east-

Ecuadorian and southeast-Colombian specimens, including the type.

There are no earlier Peruvian records.

***Eutoxeres condamini gracilis* Berlepsch and Stolzmann**

Eutoxeres condaminei gracilis BERLEPSCH AND STOLZMANN, 1902, Proc. Zool. Soc. London, p. 19—Vitoc, Perú; type formerly in Warsaw Mus., now lost.

Most of the characters given by Berlepsch and Stolzmann for this subspecies are not apparent in the specimens before me. The color of the upper parts is no different from that of the typical subspecies, the light streaks of the under parts are no wider, and the outer rectrices show only an average of lighter ochraceous coloration, not adequately diagnostic. The bill, however, is definitely weaker and presents the best character for the distinction of the two forms.

Young birds of both subspecies have the usual acuteness of the rectrices that accompanies juvenility, and in addition have prominent buff or whitish tips on the feathers of the upper surface, sometimes restricted to the lower back and uropygium, sometimes involving even the top of the head. There are also white tips on the remiges, primary-coverts, and scapulars in a varying degree of development.

A female from southeastern Perú shows these characters of immaturity and in addition has the basal portion of the outer three rectrices paler than in the males (adults and young) from central Perú, and the terminal portion of these feathers and of the submedian pair more broadly white. The blackish chin spot is smaller than in any other specimen at hand, and the light streaks on the breast are somewhat broader. In view of the fact that these characters show resemblance to those postulated for *gracilis* by Berlepsch and Stolzmann, it is possible that they represent only an extreme of individual variation of that form. A series from southeastern Perú will be necessary to determine any constant differences that may exist.

Earlier Peruvian records of *gracilis* are from Huánuco, Vitoc, Garita del Sol, Amable Maria, Pumamarca, and Paltaypampa.

SPECIMENS EXAMINED

E. c. condamini.—

COLOMBIA.

La Morelia, 1 ♂;

"Bogotá," 1 (?).

ECUADOR:

Archidona, 1 (?) (type);
"Ecuador," 1 ♂, 2 (?).

PERÚ:

Mouth of Río Curaray, 1 ♂;
mouth of Río Santiago, 1 ♂.

E. c. gracilis.—

PERÚ:

Vista Alegre, 1 ♂¹;
Huachipa, 1 ♀¹;
Chilpes, 2 ♂;
Cushi Libertad, 1 ♂,
Santo Domingo, 1 ♀.

***Campylopterus largipennis aequatorialis* Gould**

Campylopterus Aequatorialis GOULD, 1861, An introduction to the Trochilidae, p. 54—neighborhood of Quito; [♀]; British Mus.

I can find no distinctions in the series of birds from the eastern face of the Andes, from southeastern Colombia to eastern Bolivia. Birds from the Rio Madeira, Brazil, are somewhat puzzling since they show intermediacy with *C. l. obscurus* of the Pará region. A single example from the left bank of the Madeira (Marmellos) is rather clearly assignable to *aequatorialis*, and a young male from Santa Isabel, above the fork of the Gy-Paraná, approaches it in respect to the whitish gray tips on the rectrices. Another male from Santa Isabel and three specimens from the right bank of the Madeira are, in my opinion, definitely closer to *obscurus* as are a single male from the right bank of the Tapajoz and three from the Tocantins. I would place the boundary between the two forms directly on the Madeira, in conflict with Hellmayr's assignment (1910, Novitates Zool., vol. 17, p. 375) of all the Madeiran examples to *aequatorialis*.

The characters of paler under parts and more bluish green dorsal surface of the tail in *aequatorialis* as compared with *obscurus* are not so constant, according to the material at hand, as the longer and more whitish gray tips of the outer two or three pairs of rectrices. Even the length of these tips is not a safe criterion taken alone, since they may be as short in *aequatorialis* as in *obscurus*, although in most cases they are noticeably longer.

There is a record of the species (under the name of *obscurus*), ostensibly from Lima, published by Taczanowski (1874, Proc. Zool. Soc. London, p. 541; 1884, Ornithologie du Pérou, vol.

¹ Specimens in Chicago Natural History Museum.

1, p. 275). The record was queried by Berlepsch (Berlepsch and Stolzmann, 1892, Proc. Zool. Soc. London, p. 401) who obtained an admission from Taczanowski that "Lima" (but not Perú) was erroneous. It is quite possible, however, that even Perú was not the country of origin; see account of *Phaethornis malaris ucayalii* for a similar case.

Records of *aequatorialis* are from Chayavitas, Tarapoto, Huaynapata, Marcapata, and "Upper Amazons."

SPECIMENS EXAMINED

C. l. largipennis.—

CAYENNE:

(Pied Saut and Cayenne), 4 ♂, 2 ♀, 2 (?).

BRITISH GUIANA:

(Kamakusa, upper Mazaruni River, Merumé Mountains, and Potaro Landing), 3 ♂, 3 ♀, 2 (?).

VENEZUELA:

(Mt. Auyan-tepui, Sacupana, Suapure, Nericagua, Nicaré, Solano, El Merey, junction of Río Huaynia with Casiquiare, and Caño Seco [Mt. Duida]), 16 ♂, 4 ♀.

BRAZIL:

(Yucabí, Tahuapunto, and Manaos), 4 ♂, 1 ♀.

COLOMBIA:

Río Uaupés, opposite Tahuapunto, 2 ♂, 2 ♀.

C. l. obscurus.—

BRAZIL:

Pará (Utinga and Prata), 4 ♂, 4 ♀;

Rio Tocantins, Mocajuba, 3 ♂;

Rio Tapajoz, Tauarý, 1 ♂;

Rio Madeira (Calamá, Alliança, and Porto Velho), 3 ♂;

Rio Preto, Santa Isabel, 2 ♂.

C. l. aequatorialis.—

BRAZIL:

Rio Madeira, Marmellos, 1 ♂;

Matto Grosso, Barão Melgaço, 1 ♂.

BOLIVIA:

Mouth of Río San Antonio, 1 ♂;

San Agustín, 4 (?).

PERÚ:

Astillero, 3 ♂, 1 ♀, 1 (?);

La Merced, 3 ♂, 3 ♀;

Chuchurras, 1 ♀;

Santa Rosa, Río Ucayali, 1 ♂;

Lagarto, 1 ♂;

Pomará, 1 ♂;

mouth of Río Santiago, 1 ♀;

Pebas, 1 ♂, 1 ♀;

mouth of Río Curaray, 2 ♂.

ECUADOR:

Río Suno, above Avila, 3 ♂, 2 ♀;

lower Río Suno, 1 ♂, 1 ♀;

below San José, 1 ♂, 2 ♀;

"Napo," 2 ♂, 2 ♀, 3 (?);

"Ecuador," 1 [♂], 1 ♀.

COLOMBIA:

La Morelia, 1 ♂.

[*Campylopterus falcatus* (Swainson)]

Trochulus falcatus SWAINSON, 1821, Zoological illustrations, vol. 2, pl. 83—"Spanish Main" = northern Venezuela.

Cabanis and Heine (1860, Museum Heineanum, vol. 3, p. 13) recorded a young male specimen of the present species (under the name *Campylopterus lazulus*) as from Perú. Berlepsch (1889, Proc. U. S. Natl. Mus., "1888," p. 560) noted a specimen in the United States National Museum similarly labeled which he considered to be a Bogotá trade-skin. It is quite possible that Cabanis and Heine's specimen had a comparable origin. No exact locality was given on either specimen, and other undoubted Bogotá-skins have come to my attention similarly and erroneously ascribed to Perú. Without an authentic record I am unwilling to include this bird in the Peruvian list although, as does *Campylopterus villaviscensio* (Bourcier), it occurs in eastern Ecuador and may reach Perú.]

***Eupetomena macroura macroura* (Gmelin)**

[*Trochilus*] *macrourus* GMELIN, 1788, Systema naturae, vol. 1, pt. 1, p. 487—"Jamaica" (errore; subst. Cayenne, Hellmayr, 1929).

[*Trochilus*] *forcipatus* LATHAM, 1790, Index ornithologicus, vol. 1, p. 304—"Cayana."

Ornismya hirundinacea LESSON, 1829, Histoire naturelle des oiseaux-mouches, pp. xii, 98, pl. 25—Brazil.

[*Eupetomena*] subsp. *mac[rura] prasina* SIMON, 1897, Catalogue de la famille des trochilides, p. 9—"Gui., Bras. int. (Matto Grosso)"; based on Surinam specimens (Simon, 1921); Paris Mus.

Sclater (1857, Proc. Zool. Soc. London, pt. 25, p. 263) recorded a specimen of the species collected by Bates on the Río Javarri that forms the boundary between eastern Perú and western Brazil. There is no means of knowing from which side of the river the specimen came, and there is no other record of the species from nearer than the Rio Madeira (*m. macroura*) and the Uru-bamba Valley (*hirundo*). The record is not cited by Salvin in

the "Catalogue of birds in the British Museum," although Sclater mentions it in his "Catalogue of a collection of American birds" (1862, p. 287) without comment. There are no other Peruvian records except of *hirundo*, so the record may be left as it stands, with a statement of the need for confirmation.

***Eupetomena macroura hirundo* Gould**

E[upetomena] hirundo GOULD, 1875, Ann. Mag. Nat. Hist., ser. 4, vol. 16, p. 370—Huio, 4800 feet, Valley of Santa Ana, Perú; ♂, ♀ cotypes in British Mus.

This form is separable from the other subspecies by its generally duller coloration, with a strong greenish hue on the top of the head when the specimens are held away from the light, showing less distinction from the green of the back than is present in the other forms. Since the material includes two adult males, with basally expanded shafts of the outer remiges, it is obviously not due to immaturity. As a matter of fact, the specimen with the brightest color and least greenish tone on the cap is one (not sexed) just reaching maturity, with some of the immature feathering still in place. Another female, still more immature, is, however, duller than any of the others. This bird is marked as "A Type" and is one of the specimens collected at Huio by Whitely, from which Gould obtained his material for description. Still another Huio bird collected by Whitely is at hand. It is not certain, however, that Gould actually had either of these specimens in his possession at the time of description; he did not comment on the number of examples used as a basis for his *hirundo*. These two birds, therefore, are possible cotypes but not certain ones.

Several authors have commented on Bolivian examples of *macroura*, in some cases referring them to *hirundo* without assurance. I have 10 examples at hand from northern Bolivia which are different enough from *hirundo* to prevent assignment to that form, and equally different from *m. macroura*. They are intermediates, it is true, but agree so well among themselves in their distinctive characters that I believe they deserve recognition as a recognizable form. Accordingly I describe them hereunder.

The only records of *hirundo* are from Huio and Santa Ana, both represented in the material examined.

***Eupetomena macroura boliviana*, new subspecies**

TYPE: From Reyes, [Dept.] Beni, Bolivia, No. 479428,

American Museum of Natural History. Adult [? male], collected in August, 1895, by A. Maxwell Stuart.

DIAGNOSIS: Intermediate between *E. m. macroura* of Cayenne, Brazil (southward to Matto Grosso and São Paulo), and Paraguay, and *E. m. hirundo* of the Urubamba Valley, Perú, having the breast a little bluer, less violaceous, than *macroura* but more deeply hued than *hirundo*; top of the head more greenish blue than in *macroura*, but not so greenish as in *hirundo*, and more distinctly contrasting with the green of the back; all coloration clearer and more lustrous than in *hirundo*.

RANGE: Northwestern Bolivia on the Río Beni and possibly portions of Bolivia farther to the eastward.

DESCRIPTION OF TYPE: Top of the head (held away from the light) lustrous Sorrento Green × Peacock Blue, becoming a little greener on the hind neck and changing to a bright, yellowish Meadow Green on the back; a prominent white patch on the sides of the middle back (spinal tract) where they are concealed when the wings are at rest; upper tail-coverts dark steel blue, with purplish outer webs on some of the feathers. Sides of the head above like the cap, passing into the Spectrum Blue of the throat and breast; belly mostly bright Cossack Green, with anal region white; under tail-coverts steel blue. Remiges brownish black with purplish lights and with a slight trace of green on the outer webs of the tertials; outermost primaries with shafts strongly expanded on the basal half; subexternal feather with slight expansion; greater upper wing-coverts like the remiges; median and primary series with outer margins green; lesser series with exposed portions green like the back; under primary-coverts dull brown; rest of under coverts green. Tail steel blue, deeply forked. Bill (in dried skin) black; feet black. Wing, 78 mm.; tail, 86; culmen, 20.5; tarsus, 5.

REMARKS: The blue colors are less greenish or approaching violaceous when the specimen is held toward the light.

Five specimens, including the type, have the shafts of the outer primaries expanded basally and presumably are males. Two others lack this expansion but have the colors about as intense as the supposed males and are probably adult females. The remainder of the series lack the expansion of the remigial shaft but have the colors dull, being obviously young birds whose sex is indeterminate. None of the specimens was sexed by the collectors.

Todd (1942, Ann. Carnegie Mus., vol. 29, p. 290) comments on two birds from the Río Quiser, Bolivia (Río Quizer, Chiquitos, on American Geographical Society map), which he found to differ from Brazilian specimens of *m. macroura* by less intense blue of the throat, which was also less extended over the breast, and by narrower and more rounded tips on the outer rectrices, with the opinion expressed that these might be characters of immaturity. A specimen from San Lorenzo River, Matto Grosso, Brazil (now before me), he found to agree best with his Bolivian birds. Simon (1921, Histoire naturelle des Trochilidae, p. 33) had already noted birds from the Río Beni, Bolivia, as intermediate between *macroura* and *hirundo*. I am unable to appreciate the supposedly lesser extension of the blue of the cap and breast in my Bolivian material (or in *hirundo*) but find much the same extent of color in all the forms, with variations due to preparation of the skins. The shape of the tips of the outer rectrices is also difficult to appraise since it is variable, although reaching the greatest extreme of sharpness in some examples of *simoni*.

Nevertheless, it is possible that east-Bolivian birds belong to the present form. The San Lorenzo River specimen, on the other hand, is not distinguishable from *m. macroura* except that it has a slight tendency to greenish coloration on the forehead. In the hue of blue on the rest of the head and on the breast it is a good *macroura*.

Simon (1897, Catalogue de la famille des trochilides, p. 9) described a supposed subspecies *prasina* from "Gui. Bras. int. (Matto-Grosso)" without specifying a type locality. Hellmayr (1929, Field Mus. Nat. Hist., zool. ser., vol. 12, p. 387) reached the conclusion that Simon had redescribed *m. macroura*, through misidentifying as that form the population which Hellmayr thereupon named *simoni*. Simon (1921, Histoire naturelle des Trochilidae, p. 33) stated that his *prasina* had been based on two specimens labeled as from Surinam; the characters he restated are those that distinguish *macroura* from *simoni*. There is no reason, therefore, not to accept Surinam as type locality of *prasina*, which makes *prasina* quite unavailable as a possible name for the form I describe above, a possibility suggested by Todd (*loc. cit.*).

SPECIMENS EXAMINED

E. m. macroura.—

"SURINAM": [=Cayenne-skin], 1 (?).

BRAZIL:

- Amazonas (Humaythá and Santarem), 1 ♂, 2 ♀, 1 (?);
 Matto Grosso (Chapada and San Lorenzo River), 7 ♂, 2 ♀, 1 (?);
 Minas Gerais (Campos de Diamantina), 2 (?);
 Goyaz (Fazenda Esperança and Goyaz), 4 ♂, 2 ♀;
 São Paulo (Ypanemá), 2 ♂;
 Espirito Santo, 3 (?).

PARAGUAY:

- Zanja Morotí, 2 ♂.

E. m. simoni.—

BRAZIL:

- Maranhão (Barra de Grajau), 1 ♂;
 Ceará (Viçosa and Quixadá), 8 ♂, 1 ?♂, 1 ♀, 2 (?);
 Piauhý (Corrente, Floriano, Gilbues, Santa Maria, and Urussuhý), 8 ♂,
 6 (?);
 Bahia (Barra, Santa Ritta, Morro de Chapeu, Bahia, Joazeira, and
 "Bahia"), 14 ♂, 4 ♀, 9 (?);
 "Rio" (? apparently Bahia-skins), 3 (?);
 Brazil, 1 ♀.

NO LOCALITY, 2 (?).

E. m. boliviana.—

BOLIVIA:

- Reyes, 5 [?♂] (including type), 2 [♀], 4 (?).

E. m. hirundo.—

PERÚ:

- Huio, 2 ♀;
 Idma, 1 ♂;
 Santa Ana, 2 ♂, 1 "♀."

***Florisuga mellivora mellivora* (Linnaeus)**

[*Trochilus*] *mellivorus* LINNAEUS, 1758, *Systema naturae*, ed. 10, vol. 1, p. 121—"India" (*errore* = Surinam); *ex* Edwards, *Natural history of uncommon birds*, p. 35, pl. 35, upper fig.

Mellisuga surinamensis STEPHENS, 1826, *in* Shaw, *General zoology*, vol. 14, p. 243—Surinam.

Florisuga salli BOUCARD, 1891, *Humming Bird*, vol. 1, p. 18—South México; ?Paris Mus.

F[lorisuga] guianensis BOUCARD, 1895, *Genera of humming birds*, p. 340—Demerara and River Atapuroni, British Guiana; ?Paris Mus.

F[lorisuga] peruviana BOUCARD, 1895, *Genera of humming birds*, p. 340—Ecuador and Pebas, Perú; ?Paris Mus.

Florisuga mellivora speideli FLOERICKE, 1920, *Mittheil. über die Vogelwelt*, vol. 19, pp. [2-4]—Colombia ?

Mouth of Río Curaray, 1 ♂, 2 ♀; Puerto Indiana, 1 "♂"
 [= ♀], 1 ♀; Iquitos, 1 ♂, 1 ♀; Pebas, 3 ♂; Huarandosa, 3 ♂,
 1 ♀; Yurimaguas, 1 ♂; mouth of Río Santiago, 1 ♂; Santa

Rosa (Río Ucayali), 12 ♂, 9 ♀; Yarina Cocha, 1 [♀]; Pachisa, 1 ♀; Astillero, 1 ♂; "Perú," 1 ♂.

This is one of the most widely distributed hummingbirds, ranging unchanged, apparently, from southern México to southern Perú, Bolivia, and central Brazil, and to Venezuela, the Guianas, and Trinidad. The Tobago form, *F. m. flabellifera*, averages larger (wing, tail, and bill) than the birds of the rest of the specific range, but otherwise is not distinct as far as I can determine. Specimens have been examined from Guatemala (10), Nicaragua (2), Costa Rica (19), Panamá (30), Colombia (36), Venezuela (45), Trinidad (10), British Guiana (2), Surinam (3), Cayenne (2), Brazil (26), Bolivia (5), Ecuador (15), and unspecified (4). Of *flabellifera* I have examined 19 from Tobago.

Other Peruvian records are from Jeberos, Chayavitas, Chamicuros, Callacate, Río Javarri, and "Upper Amazons."

The study of the 250 specimens from various parts of the range of *F. m. mellivora* has brought to light some interesting facts concerning the plumages that appear to have escaped previous record. Six types of plumages are in evidence, with various stages of intermediacy between some of them and not always clear distinction between females and males, demonstrating with some certainty that the females are dimorphic. The plumages are as follows:

A. Back rather dull green, with a prominent light brownish stripe from the middle of the mantle to the lower rump, with traces of brownish tips on some other feathers on head and back, particularly the upper tail-coverts; white patch on the hind neck well developed, sometimes with a brownish tinge posteriorly; top of the head greenish or dull bluish, with remains of brownish feathers that suggest a still earlier stage of more general brownish coloration. Chin, throat, and chest steel blue (sometimes varied by brownish or whitish terminal margins), forming a large patch that is bordered laterally by a broad stripe of buffy brown; sides of breast, lower breast, and flanks dull brownish; belly and under tail-coverts pure white. Three median rectrices basally white and quite narrowly tipped with white, with a subterminal, broad band of dull steel blue, more sooty proximally, and passing basad along the outer margins of the feathers; outer two pairs white, occasionally with a dark subterminal band on one or both of them, and with a dark stripe along the outer margin of the subexternal feather; subexternal feather usually longest.

B. Apparently an intermediate stage between A and C. Top of head bluish but not so deep blue as in C and D; nuchal patch variable in extent, point of chin brownish buff like the malar stripe; throat and chest blue, sometimes with whitish or brownish tips; tail as in A.

C. Whole head and upper part of the breast violaceous blue; greenish on the occiput; a few gular feathers sometimes with narrow tips of white or brownish; white nuchal patch broad and clear white; rest of upper parts shining green. A band of green across lower breast, widest laterally. Tail and under tail-coverts as in A.

D. Head and body as in C, but tail white except for a narrow terminal band of bluish black, passing basad in a narrow marginal stripe on all but the outermost feather which is usually the longest.

E. Upper surface nearly uniform green, with the white nuchal patch usually reduced and weak, sometimes strong. Point of chin white; throat and chest occupied by particolored feathers which have a rounded central spot of green or bluish color, bordered by a prominent white lunule which is followed by a narrow terminal margin of brown or blackish brown; malar stripe whitish, often with some traces of dark terminal margins; breast, sides, and flanks with dull greenish centers, drab subterminal lunules, and inconspicuous terminal edges; belly dull whitish; under tail-coverts with strong white tips, preceded by a broad, blackish, subterminal band showing a certain amount of bluish or greenish reflections. Tail largely dark green or bluish green, with a broad subterminal band of varying width and dark steel blue color, narrowly tipped with white; outermost pair largely bluish black with the white tip decidedly broader and with the basal half or so of the outer web grayish or dull whitish, at least along the outer margin, rarely continuing distad to join the white tip.

F. Similar to B but point of chin and malar stripe whitish, sometimes with dusky tips; throat and chest blue or greenish blue with remains laterally of the squamate gular markings of E; shorter tail-coverts as in E, but longer median ones as in A, B, and C—pure white. Apparently a development from E but not impossibly intermediate between E and C.

The specimen showing the most complete pattern of A is not sexed, but several males have advanced but little beyond it, indicating that A is an immature plumage of the males. One female (as sexed) is in this plumage, not complete, and there is other

evidence that this sex may have something like it, as will be mentioned below. The males, however, pass from A through B to C by what seems to be a protracted molt, losing the dorsal stripe, acquiring a more strongly green back, and getting a bluer tone on the top of the head. Traces of the malar stripe, and even of the pale-tipped feathers of the throat, when they have been present in A, persist the longest, and it is possible that C constitutes a "first winter" plumage that is worn until the next breeding season; it is not inconceivable that some young males may wear B during this period.

The change from C to D is made by molting the immature tail and acquiring rectrices of the fully adult pattern. Probably the remiges are similarly changed, but without noticeable change in pattern it is not demonstrable. I have no males marked as with enlarged gonads except in plumage D. With two exceptions, presumably wrongly sexed by the collectors, all specimens with D are sexed as males if the sex is recorded on the labels, and all the birds sexed as males, with two exceptions, fit into the series A to D.

It is in the females that diversity is most striking. Plumage E is shown by about two-thirds of all the females at hand, including individuals with various indications of immaturity (weak texture of plumage, dull colors, somewhat undeveloped bills, or even a notation of immaturity given by the collector) and others that are certainly adult, including one marked as with ovaries greatly enlarged. None of the younger examples, however, has so immature an appearance as the youngest males in plumage A. Nevertheless, I believe that E constitutes a standard female plumage that is worn by some young females and some adults. One example shows the tail molting without change of pattern. This is the plumage that has heretofore been recorded as *the* female plumage.

There are, however, some 30 specimens at hand (about one-third of all the females), sexed as females by such veteran collectors as Cherrie, Hoffmanns, the Olalla brothers, Klages, Rosenberg, Watkins, and others, that show the plumages B, C, and F, and even remains of A. It is difficult to believe that they were all erroneously sexed, especially since one B and one C are marked as with somewhat enlarged gonads, and one F has the symbol ♀ double-underlined for emphasis. I can find no indication of molt from the tail of E to the tail of F, but such change may sometimes take place; the males assuredly must change the tail of C to that

of D in the last stage of molt, although that also is not actually shown in progress in any of my material.

There is ample evidence of the development of the blue gular area of F from the squamate pattern of E, and one female in process of such change is renewing the dark-tipped feathers of the malar region and sides of the throat at the same time, suggesting that plumage F may persist, not inconceivably as a fully adult stage in some cases. One female in C also is noted as with enlarged gonads.

Three "females" are in plumage C, resembling adult males except for the tail, which is that of the immature males, and since one of the three is marked as with somewhat enlarged gonads (three males collected at the same time had greatly enlarged testes), it is evident that certain "advanced" females may reach this stage as breeding adults.

One female, as noted above, is in modified plumage A; 11 are in B, with three of them showing pale tips on the blue throat feathers but none of the quite different lunate markings of E and F; one bird is in probable B, although the malar stripe is paler and more buffy whitish than in the 11 mentioned; 10 are in F; one is in E, except that the tail is that of A, B, C, and F, just completing change from an unknown antecedent but giving a most puzzling combination.

One bird of uncertain sex is in plumage E, apparently renewing the tail of that plumage but replacing with blue the squamulate pattern on the sides of the throat. One female in F has the left median rectrix as in plumage A, while the rest of the tail remains of the usual F pattern; no molt is evident. Still another of this sex has the two external left rectrices of modified adult-male type and the two right external ones modified E feathers, while the rest of the tail is that of A, B, C, or F; an obviously abnormal condition.

The general weight of evidence leads me to conclude that some females have the early stage E and progress to F; some remain in E; and perhaps some retain E with a certain amount of blue color established on the throat. On the other hand, some presumably start with A, as do the males, and pass through B to C, while others may possibly remain in B. The possession of enlarged gonads by birds in B, C, and E is significant. Whether any females starting with E reach C remains to be determined, but if F is a development from E, the further progress to C is not diffi-

cult to postulate. There is also the still smaller possibility that very "advanced" females might reach D, as intimated by the two specimens sexed as females but in full adult male plumage, which I consider as probably wrongly sexed.

The distribution of the different plumages in the material studied is as follows:

A	7♂	1♀
B	42♂	12♀
C	9♂	3♀
D	97♂	[22♀]
E	0	57♀
F	[2♂]	10♀

There is an excellent opportunity for field investigation on this problem, and it is hoped that someone favorably situated may undertake the full elucidation of the points still requiring explanation.

It is interesting to note that in *Florisuga fusca* of southeastern Brazil the pattern of the tail is different in young and fully adult males, and the young males have a deep brown malar stripe that they lose before the rectrices are changed. Furthermore, there is some evidence that certain females resemble the young males while others are quite different, paralleling rather exactly the circumstances in *mellivora*. These facts add weight to my belief that *fusca* is not generically distinct from *mellivora*, a belief in accord with the nomenclature adopted by Berlioz (1934, L'Oiseau et Rev. Française d'Ornith., vol. 4, no. 3, pp. 414, 419).

One of the characters commonly used to substantiate a claim for the recognition of "*Melanotrochilus*" as a separate genus is the normal length of the upper tail-coverts in contrast to the lengthened ones of *Florisuga*. I do not consider this character of generic value. The probable function of the added length of these feathers in *Florisuga* is the concealment of the conspicuous white basal area of the tail. In the young males and those females that have white on the median rectrices, the median upper coverts are shorter than they are in the adult males, though still long enough to conceal the white when the tail is closed. In the females with green tails, these coverts are also of moderate length. In the species *fusca* the median rectrices themselves are dark in color, and there is no need for elongate coverts to effect a concealment of the white on the adjacent tail feathers. It is a simple utilitarian modification of plumage, not greatly significant.

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A REVISION OF NORTH AMERICAN SHARKS ALLIED TO THE GENUS *CARCHARHINUS*¹

BY STEWART SPRINGER

Unpublished results of field studies made at Bimini in 1948 and in the Gulf of Mexico and the Caribbean in 1948 and 1949 have provided new indications of phylogenetic relationships of carcharhinid sharks and permit a fresh approach to the taxonomic problems of the group. Subdivision of *Carcharhinus* by the particular alternative character, the presence or absence of a middorsal skin ridge, was first used as a criterion for the identification of species of *Carcharhinus* by Nichols and Breder² (1927, pp. 15-16), and was noted by Bigelow and Schroeder (1948, p. 322) as the only one that might form a basis for a sharp-cut subdivision of the genus. This splits *Carcharhinus* into two major groups that coincide with groups recognizable from the point of view of ecology. However, both subgroups become more convenient categories with further revision. The partial revision of the genera undertaken here is necessarily made with little reference to species of regions outside the western north Atlantic. It is hoped that the outline of characteristics will encourage and aid work towards a complete revision of the Carcharhinidae into convenient natural categories. Incomplete lists of species found

¹ A contribution of the Lerner Marine Laboratory of the American Museum of Natural History.

² Partly in error for *Carcharhinus obscurus* noted as having "no ridge on back." *Eulamia obscurus* (= *Carcharhinus obscurus*) has frequently been confused with *Carcharhinus leucas* (= *C. commersoni*), a species without a middorsal ridge, in identification of specimens from the northeastern coast of the United States. Both forms occur in the vicinity of New York Harbor, but this is near the northern limit of the range of *leucas*.

outside the western north Atlantic and referred to genera discussed here are made up from results of examinations of some specimens in the collection of the United States National Museum, a small collection made by Price M. French on the Pacific coast of Panama, and also from the literature but with particular reference to publications of Bigelow and Schroeder (1948), Whitley (several reports, see bibliography), and Beebe and Tee-Van (1941).

KEY TO WESTERN NORTH ATLANTIC GENERA OF
CARCHARINIDAE WITHOUT SPIRACLES

1. Labial grooves extending along the sides of the jaws for a distance as great, or nearly as great, as one-half the diameter of the eye.
 *Scoliodon* Müller and Henle
 Labial grooves very short or absent. 2
2. No trace of a ridge in the skin between the first and second dorsal fins. 3
 Middorsal ridge present (in fresh or well-preserved specimens) 6
3. Second dorsal fin relatively small, its area much less than half the area of the first dorsal. 4
 Second dorsal fin large, its area nearly half as great, or in some cases nearly as great, as the area of the first dorsal. 8
4. Midpoint of base of first dorsal nearer to insertion of pelves than to axil of pectoral. *Prionace* Cantor
 Midpoint of base of first dorsal nearer to axil of the pectoral than to insertion of the pelves. 5
5. Upper jaw teeth finely or coarsely serrate; gill slits of moderate length, the longest less than half the length of the base of the first dorsal.
 *Carcharhinus* Blainville
 Upper jaw teeth smooth edged; gill slits relatively long, the longest nearly half the length of the base of the first dorsal. *Aprionodon* Gill
6. Tips of pectorals and of the first dorsal broadly rounded in adults.
 *Pterolamia*, new genus
 Tips of pectorals and first dorsal acuminate. 7
7. Cusps of upper jaw teeth serrate. *Eulamia* Gill
 Cusps of upper jaw teeth smooth, bases dentate.
 *Hypoprion* Müller and Henle
8. Snout short and broadly rounded. *Negaprion* Whitley
 Snout relatively long, pointed. *Isogomphodon* Gill

GENUS ISOGOMPHODON GILL

Isogomphodon GILL, 1862, Ann. Lyc. Nat. Hist. New York, vol. 7, p. 401; type species, *Carcharias oxyrhynchus* Müller and Henle, 1841.

The type species, *oxyrhynchus*, is not well known. It differs from its western Atlantic relatives in having a larger number of tooth rows, 49 in the upper jaw of the type. The teeth are similar in the upper and lower jaws, serrate, and have narrow

cusps on broad bases. The type species is also characterized by a relatively large second dorsal fin, broad pectorals, and a pointed snout. In addition to the type species, the genus probably includes the oriental *Carcharias temminckii* of Müller and Henle.

GENUS NEGAPRION WHITLEY

Negaprion WHITLEY, 1940, Fishes of Australia, Part 1, The sharks, etc., Sydney, p. 111; type species, *Aprionodon acutidens queenslandicus* Whitley, 1939, Australian Zool., vol. 9, p. 233.

Species referred to *Negaprion* are *Aprionodon queenslandicus* of Whitley, *Carcharias acutidens* of Rüppell, and *Hypoprion brevirostris* of Poey. *Carcharias fronto* of Jordon and Gilbert is regarded as a synonym of *brevirostris*.

GENUS APRIONODON GILL

Aprionodon GILL, 1862, Ann. Lyc. Nat. Hist. New York, vol. 7, pp. 400, 401, 411; type species, *Aprionodon punctatus* Gill, equals *Carcharias isodon* Müller and Henle, 1841.

Aprionodon is represented in the western north Atlantic by the type species, *isodon*, a form rare in collections. This shark has appeared in relatively large numbers in less than 10 fathoms off Salerno, Florida, during December and January in 1945, 1947, 1948, and in January, 1949, but has not been taken in other months. No doubt the species appears every year, but adults are too small to be of interest to the commercial fishery and runs last only a few days, usually during the Christmas holidays. It appears likely that *Aprionodon* is common for short periods from Long Island to Texas and that winter runs on the Florida coast are a phenomenon of the breeding cycle.

In a sample of 20 adult females of *Aprionodon* taken off Salerno on December 28, the total length ranged from 58 to 61 inches. Of this lot, 13 had from one to six embryos, 17 to 19 inches long. The seven remaining had ovarian eggs about 15 mm. in diameter and enlarged flaccid oviducts indicating recent birth of young. In other collections at Salerno, adult males from 55 to 60 inches long were taken. It is evident from this and other data that the *Aprionodon* of the Florida runs produce typically six young about 19 inches long in December and January, and that a yolk-sac placenta is formed during the development of the embryos. Schools of adults of either sex appear in inshore waters near Salerno, but mixed schools have not yet been encountered.

Immature *Aprionodon* have been taken on hook and line by the writer, although uncommonly. These were caught at night in anchorages on the west coast of Florida and on the coast of Mississippi and gave the impression of being timid or uninterested feeders. The Salerno adults were taken by gill nets of a type infrequently used in the southeastern states. From fishing experience and from the various records available, there is neither positive nor negative evidence that *Aprionodon* is absent from moderate depths on the southeastern coasts at any season, nor is there evidence that the species migrates for long distances. Mature specimens from the Gulf of Mexico have not been taken for examination nor are they mentioned in the literature. As a complication, comparison of new-born summer young from the coast of Texas with winter late embryos from Salerno indicates that there are two American forms of *Aprionodon* and that the Texas and north Gulf of Mexico population may represent an undescribed species. This illustrates a condition frequent in tropical carcharhinid sharks, in that structurally differing but closely allied pairs of forms occur and that a feature of this kind of complex is a winter breeding season for one form and a summer breeding season for the other. For the few well-known species, gestation periods for tropical carcharhinid sharks are more than six months. But since the geographical ranges of pairs of forms overlap and since the meager life history data have not been correlated with minor structural differences, the status of these pairs of forms has not been determined.

Aprionodon differs from *Carcharhinus*, as defined here, only in that it has longer gill slits and smooth-edged teeth. It is structurally close to the black-tips included in *Carcharhinus*. A generic arrangement (as here) that leaves the black-tips in the genus *Carcharhinus* while placing the smooth-toothed sharks in a separate genus, *Aprionodon*, is admitted to be unsatisfactory. But because of the large number of inadequately described species of these genera, it seems undesirable to attempt further revision without examination of representative material from regions other than the western north Atlantic.

GENUS *CARCHARHINUS* BLAINVILLE

Carcharhinus BLAINVILLE, 1816, Bull. Soc. Philom. Paris, vol. 8, p. 121; 1816, Jour. Phys. Chem. Hist. Nat., vol. 83, p. 264; in Vieillot, 1825, Faune Française, p. 88; type species, *Carcharhinus commersoni* Blainville, 1816, 1825.

Since *commersonii* is a compound of *leucas* of Muller and Henle and *longimanus* of Poey, *Carcharias leucas* Muller and Henle is designated the genosyntype.

GENERIC CHARACTERS

Carcharhinidae without spiracles; caudal peduncle without lateral ridges; precaudal pits above and below, the upper usually stronger; first dorsal fin approximately triangular, its apex not broadly rounded in adults; second dorsal fin much smaller than first dorsal, its area less than half the area of the first dorsal; upper labial grooves short or obsolete, no lower labial grooves; no ridge in the skin between the two dorsal fins; midpoint of base of first dorsal nearer the axil of the pectoral than the insertion of the pelvics; gill openings moderate, the longest less than half the length of the base of the first dorsal; eyes relatively small; development viviparous, a yolk-sac placenta formed; number of young at birth fewer than 16, moderately large in comparison with the adult; teeth of upper jaw with finely or coarsely serrate cusps.

DISCUSSION

Carcharhinus includes several natural subgroups and remains the repository for an assortment of poorly defined forms of uncertain relationship. Its separation from either *Aprionodon* or *Prionace* is not clear cut. The black-tips of tropical America, *Carcharhinus limbatus* (Müller and Henle), *C. maculipinnis* (Poey), and *C. aethalorus* (Jordan and Gilbert), appear to be representative of a group with world-wide distribution in tropical seas. The Pacific species *aethalorus* is close to *maculipinnis* in size and in the shape of the teeth of the lower jaw. The status of the smaller Pacific black-tip is uncertain. It has been described as *Carcharhinus natator* Meek and Hildebrand, but evidently the populations on the Atlantic and Pacific sides of Panama show no structural differences. The Florida-Antillean *C. limbatus* in series comparison with Texas specimens of similar size has a longer snout and extremes from the two localities are quite different in superficial appearance. The available evidence suggests that *natator* is a subspecies of *limbatus* and that its range extends from unknown limits in Pacific tropical American waters along the Atlantic mainland coasts from the Orinoco to the Mississippi where it intergrades with the typical *limbatus*. The Atlantic American black-tips are active sharks that tend to form large migratory schools.

Summer and winter ranges of these species have not yet been defined, and specimens have not been taken in deep water.

Small species of *Carcharhinus* such as *C. acronotus* (Poey) and *C. porosus* Ranzani are not well known, and their relationships are not clear. These two species are littoral. Both show strong habitat preference, *porosus* for mud bottom near the mouths of large rivers from the Mississippi to the Amazon, and *acronotus* for sand or coral mud bottom from Pensacola through the West Indies to the coast of South America. *Carcharhinus velox* Gilbert, from the Pacific coast of Panama, is the only member of the genus known to me that has transverse nasal apertures.

The type species, *Carcharhinus leucas*, is a large (adults 7 to 9 feet long), heavy-bodied, blunt-headed, and small-eyed form that is common in shallow water and reaches peak abundance near the mouths of large rivers during its summer breeding season. The young frequent bays and are more common where the water is slightly brackish. The adults appear in great concentration near the mouth of the Mississippi from May through July and produce their young there. The species disappears from inshore waters of the north Gulf of Mexico with the onset of cold weather and becomes relatively more abundant then along the Florida coast in the vicinity of the Florida Keys. At the mouth of the Orinoco River adults are found in considerable numbers, but there and in the Caribbean data are not available to show whether the species is migratory. *C. nicaraguensis* (Gill and Bransford) of Lake Nicaragua and *C. azureus* (Gilbert and Starks) are closely allied to *leucas*. The oriental *Carcharhinus gangeticus* (Müller and Henle) also probably belongs to this group.

GENUS PRIONACE CANTOR

Prionace CANTOR, 1849, Jour. Asiatic Soc. Bengal, vol. 18, p. 1381; type species, *Squalus glaucus* Linnaeus, 1758.

This form has not been certainly reported from the coasts of Florida, the Gulf of Mexico, or the Caribbean. About Florida and the Bahamas the partly pelagic ridge-back *Eulamia floridanus* may occasionally be confused with it.

GENUS SCOLIODON MÜLLER AND HENLE

Scoliodon MÜLLER AND HENLE, 1837, Sitz. Ber. Akad. Wiss., Berlin, p. 114; 1841, Systematische Beschreibung der Plagiostomen, p. 28; type species, *Scoliodon (Scoliodon) agaleus* Müller and Henle, 1837.

The tropical Atlantic American species, *Scoliodon terra-novae* (Richardson) and *S. lalandii* (Muller and Henle), have an overlapping distribution. However, the writer has observed unmixed breeding populations of *terra-novae* on the Mississippi coast and of *lalandii* near the mouth of the Orinoco. Bigelow and Schroeder (1948, pp. 295-303) include *lalandii* as a synonym of *terra-novae* and in their description state that the species has no middorsal ridge. A preserved specimen at hand of the sharp-snouted (*lalandii*) form shows a middorsal ridge clearly. Off Bimini, adults of the broad-snouted form (*terra-novae*) were taken at night at the surface several miles off the Bahama Bank shelf over a depth of more than 200 fathoms and were characterized by an interdorsal ridge as well as unusually vivid markings of white spots and white edges on the fins. On the other hand, my notes on examination of some fresh specimens of *terra-novae* from the Mississippi coast include the statement, "no interdorsal ridge." It seems evident that our present knowledge about *Scoliodon* is not sufficient to make use of the skin ridge as a specific character or to reach the conclusion that the morphological differences of western north Atlantic specimens result from variation within a single species.

PTEROLAMIA, NEW GENUS

TYPE SPECIES: *Squalus longimanus* Poey (1861, *Memorias*, vol. 2, p. 338); *Prionodon longimanus* Poey (1861, *Memorias*, vol. 2, pl. 19, figs. 9, 10).

GENERIC CHARACTERS

Carcharhinidae without spiracles; caudal peduncle without lateral ridges; first dorsal fin rounded at its apex in adults as well as in young; a ridge in the skin between the dorsal fins, often inconspicuous but present at all ages; second dorsal fin much smaller than the first dorsal; pectoral fins very long, their tips rounded in adults; teeth of upper jaw subtriangular, their outer margins progressively more concave towards the angles of the jaws, serrate; teeth of lower jaw narrower on broad bases, erect, cusps finely serrate.

DISCUSSION

Apparently *longimanus* is the only species described from the western north Atlantic. A second species, probably belonging to

this genus, is *Carcharias insularum* of Snyder, described from the Hawaiian Islands. *Pterolamia longimanus* is a little-known, pelagic species.

GENUS *EULAMIA* GILL

Eulamia GILL, 1862, Ann. Lyc. Nat. Hist. New York, vol. 7, p. 401 (name), p. 410 (diagnosis); type species, *Carcharias (Prionodon) milberti* Müller and Henle, 1841.

GENERIC CHARACTERS

Carcharhinidae without spiracles; caudal peduncle without lateral ridges; nasal apertures oblique; first dorsal fin not rounded at the tip in adults; a ridge in the skin extending for some part of the distance between the first and second dorsal fins¹; second dorsal fin much smaller than the first dorsal; pectorals strong (stiff), narrow and falcate in the young, falcate or not falcate in adults, their tips acuminate; teeth of upper and lower jaws dissimilar; teeth of upper jaw with wider cusps, the cusps somewhat flattened, with serrate edges, frequently but not always sub-triangular; teeth of lower jaw with narrow lanceolate cusps on broad bases, serrate or finely serrate; viviparous species, fewer than 16 proportionately large young to the litter, a yolk-sac placenta formed; moderate to large species, adults of species of the western north Atlantic 6 to 12 feet long.

KEY TO *Eulamia* OF THE WESTERN NORTH ATLANTIC

1. Denticles imbricate; pectoral fins of adults notably falcate; second dorsal fin low, its area much less than the area of the anal fin.....4

¹ The ridge-backs are not only difficult to identify but are not well known. Some of the confusion in the classification of the Carcharhinidae comes from failure to recognize the ridge as a reliable, convenient, and therefore important characteristic of a natural group. The ridge is not conspicuous but is always discernible in fresh specimens of *Eulamia*. Specimens exposed to the sun after death for a prolonged period or specimens preserved in such a way that the skin shrinks or stretches may fail to show the ridge. The type specimen of *Carcharias lamiella* Jordan and Gilbert is an immature example and does not now show any indication of the presence of a middorsal ridge. Nevertheless, in the opinion of the writer, *lamiella* is a ridge-back form and properly in the genus *Eulamia* as restricted here. It is unfortunate that young specimens of large carcharhinid sharks are difficult to identify or are unidentifiable if poorly preserved, especially since nearly all type specimens of the larger forms are late embryos or young. It is suggested that the weakness in the system of definition of species in this group can best be remedied by more thorough description and diagnosis based on series including adults.

- Denticles not imbricate; pectoral fins of adults with only slight concavity of distal margins; second dorsal fin relatively high, its area as great, or nearly as great, as the area of the anal fin.....2
2. Length of snout (from front of mouth) of adults less than width of mouth; origin of first dorsal in advance of the free inner posterior angle of the pectoral; large teeth of the first two rows of the upper jaw, counting from the symphyseals, about as high as the width of their bases.....3
- Length of snout (from front of mouth) of adults about equal to width of mouth; origin of first dorsal over, or nearly over, the free inner angle of the pectoral; large teeth of the first two rows of the upper jaw, counting from the symphyseals, about one and one-half times as high as the width of their bases.....*Eulamia altima*, new species
3. Denticles heavy, with strong ridges, close set, not showing much skin area between denticles; American range, north and northeast coasts of South America, and probably the coast of Central America in the Caribbean as far as the Yucatan Channel.....*Eulamia plumbeus* (Nardo)
- Denticles lighter in structure, with wider spaces between; range, Atlantic coast of the United States from Cape Cod to the Bahamas, Cuba, and the east Gulf of Mexico, probably migratory throughout its range.....*Eulamia milberti* (Müller and Henle)
4. Number of tooth rows in half the upper jaw and not including the symphyseals typically 13 or 14, rarely 12 or 15; pectoral fins thin, light in weight.5
- Number of tooth rows in half the upper jaw and not including the symphyseals typically 15 or 16, frequently 14 (in *obscurus*) or 17 (in *floridanus*) but never 13; pectoral fins heavy.....6
5. Second dorsal fin low, free corner of fin more than twice as long as vertical height of fin.....*Eulamia falciformis* (Müller and Henle)
- Second dorsal fin higher, its free corner less than twice as long as its vertical height.....*Eulamia springeri* Bigelow and Schroeder
6. Denticles small, their ridges and apical points weak, skin relatively smooth; larger teeth of the upper jaw usually notched on both margins, serration coarser and stronger at the notches; second dorsal fin low.....
-*Eulamia floridanus* (Bigelow, Schroeder, and Springer)
- Denticles large, their ridges and apical points strong, skin relatively rough; teeth of upper jaw notched on their outer margins; second dorsal fin higher.....*Eulamia obscurus* (Lesueur)

Eulamia altima, new species

HOLOTYPE: An immature female, 52 inches long, taken off Cosgrove Reef, Florida Keys, April 2, 1947, in 95 fathoms, U.S.N.M. No. 133828.

DESCRIPTION: A *Eulamia* with a ridge in the skin extending for some part of the distance between the two dorsal fins; head long; snout long, its length from the front of the mouth about equal to the width of the mouth, its tip broadly rounded, but little flattened; nasal apertures oblique, large, located about half-way between the tip of the snout and the orbit, set in longitudinal

depressions or channels about as wide as the apertures; nasal flap moderate, not very slender or pointed; eyes moderate, the diameter about equal to one-half the height of the first gill opening; gill slits moderate, the first four of nearly equal height, the fifth shorter by one-third; pectoral fins moderately wide, slightly falcate (holotype is immature; adults have pectorals not notably falcate), inserted under fourth gill opening; first dorsal fin moderate, its apex not broadly and regularly rounded, its origin near a vertical through the free inner posterior angle of the pectoral; second dorsal fin not very low, its area only a little less than the area of the anal; anal fin with a deep notch; insertion of the pelvic fins nearer the base of the anal than the base of the first dorsal; denticles small, not imbricate, without projecting points, with three ridges and sometimes with two additional lateral ridges visible under higher magnifications; teeth of upper jaw in 15-2-15 rows; teeth of lower jaw in 14-1-14 rows; upper symphyseals hooked, their cusps almost crossing; teeth of upper jaw serrate, the first two rows, counting from the symphyseals, isosceles about one and one-half times as high as the width of their bases; the teeth of rows 5 to 8 of the upper jaw with wider bases and with cusps slightly inclined towards the angles of the jaws, their height as great as, or greater than, the width of their bases; the teeth of rows 9 to 15 of the upper jaw progressively lower, smaller, and with deeper lateral notches; teeth of lower jaw with narrow cusps on broad bases, erect, very finely serrate; color in life light gray above, whitish below, lower sides of pectoral tips darker.

DIAGNOSIS: *Eulamia altima* is a large species. The mean total length of 11 adult males from Bimini and south Florida was 94.6 inches (85 to 105 inches), and the mean length of 15 adult females was 99.8 inches (89 to 111 inches). The species resembles *E. milberti*, although it is slightly larger. It is sufficiently different in outward appearance so that it has acquired a common name, Knopp's Shark, in the Florida shark fishery where it makes up a substantial portion of the catch from bottom-set lines in more than 50 fathoms. The head and snout of *altima* are longer than in *milberti*, and the first dorsal fin is not so high. The comparatively longer head, shorter post-pelvic trunk, the longer snout with prominent nasal channels, in combination with the high erect teeth, triangular near the symphyseals, serve to set *altima* off from all the other ridge-backs of the Caribbean region. The teeth of *altima* are very much like those of an adult specimen from

the Pacific coast of Panama provisionally identified as *E. galapagensis*, but in *altima* the snout is longer and heavier.

Eulamia altima belongs to the subdivision of the genus having non-imbricate denticles with more or less skin showing in the denticle interspaces. Skin samples from a point about midway between the pectoral and the first dorsal of an adult *altima* collected off Bimini had denticles approximately 0.3 by 0.4 mm. as compared to 0.45 by 0.7 for denticles from a similar sample of skin from *milberti*. Both *altima* and *milberti* show scattered, opaque, turquoise-colored denticles in living adults, but *altima* specimens have not been observed to exhibit the iridescent quality to be seen in the skin of living *milberti* out of water. Typical denticles of both species are five-ridged in adults, but in *altima* the lateral ridges are very weak, inconspicuous, and near the denticle rims. A form common on the north coast of South America, provisionally identified as *E. plumbeus*, differs from *milberti* in having larger, heavier, and more closely spaced denticles and is consequently well separated from *altima*.

The denticles of *Eulamia floridanus* are imbricate and have such weak ridges and points that the skin is smoother to the touch than the skin of *altima*. The denticles of other allied West Indian species, *falciformis*, *obscurus*, and *floridanus*, are imbricate and have strong ridges with posteriorly projecting points. Also, *falciformis*, *obscurus*, and *floridanus* differ from *altima* in having lower second dorsal fins and falcate pectorals as adults.

The dusky shark, *Eulamia obscurus*, is represented in the western north Atlantic and Caribbean region by two forms with overlapping geographical distribution, but the available material is not sufficient to show whether or not there are two species. The dusky shark is a large form that reaches maturity at a length of about 9 feet and attains lengths of more than 11 feet. The reef sharks, *falciformis* and *springeri*, need more study for determination of the status and characteristics of each form.

RANGE: *Eulamia altima* appears to be the most common large shark of the edges of the continental shelf in the West Indian region. It has been taken off Bimini, on the coast of Florida from off Cape Canaveral to Tortugas, off the coasts of Nicaragua and Costa Rica, and in the deep water in the Dragon's Mouth at the entrance to the Gulf of Paria. On the east coast of Florida both adults and immature have been taken off Fort Pierce in 75 fathoms. Embryos 24 inches long, seven in the litter and eight in

another, were collected in May off Salerno, Florida. Embryos 23 inches long were collected from the Dragon's Mouth in April. At Salerno, *altima* has been taken, although rarely, in depths as shallow as 20 fathoms. In the deeper parts of its range *altima* is often taken along with *Hypoprion signatus*, but apparently it is rare in depths as great as 200 fathoms or in lesser depths than 50 fathoms. It evidently does not frequent the surface as does the semi-pelagic *Eulamia floridanus*, nor are the young known to appear on the relatively shallow offshore banks as do the young of *floridanus*.

SPECIES REFERRED TO *Eulamia*

It seems probable that *Eulamia* as restricted here includes a larger number of species than any other genus of sharks. It is also very likely that a large number of species remain undescribed, and certainly many are inadequately described. These sharks are numerically dominant in the tropics and subtropics outside bays and shallows. Some species appear to be pelagic to a greater extent than generally realized. About Florida and northward they tend to form very large schools and are strongly migratory. Their movements are greatly influenced by water temperatures, and each species appears to have narrowly circumscribed preferences in habitat, nursery grounds, and feeding.

Very little of the literature on sharks outside the western north Atlantic includes descriptions sufficiently detailed to permit identification of sharks of this genus. An exception to this is some of the recent work of Whitley on sharks of Australia. However, *Eulamia* as used here is restricted to ridge-backed forms, whereas Whitley's comparable group is apparently the subgenus *Galeolamnoides* Whitley, 1934. The Australian species *Carcharias macrurus* of Ramsay and Ogilby, *Carcharias stevensi* of Ogilby, *Galeolamna eblis* of Whitley, and *Galeolamna dorsalis* of Whitley are among those that may belong in this genus as restricted. Australian species allied to *Eulamia* are evidently more numerous and varied than West Indian species and present a very difficult problem in classification, the more so since carcharhinid sharks of the rest of the Pacific are so little known. Notes on specimens examined by the writer and provisionally identified place the Pacific species *Carcharias lamiella* of Jordan and Gilbert, *Carcharias galapagensis* of Snodgrass and Heller, *Carcharias dussumieri* of

Müller and Henle, and *Carcharias japonicus* of Jordan and Fowler in this genus.

GENUS *HYPOPRION* MÜLLER AND HENLE

Hypoprion MÜLLER AND HENLE, 1841, Systematische Beschreibung der Plagiostomen, Berlin, p. 34; type species, *Carcharias (Hypoprion) maclovi* Müller and Henle, 1841, designated by Jordan and Gilbert, 1883, Bull. U. S. Natl. Mus., vol. 16, p. 61.

The distinction between *Hypoprion* and *Eulamia* has been made primarily on the basis of the structure of the teeth (see key to genera), but it seems probable that better generic definitions can be found. *Hypoprion signatus* Poey, the only species known from the western north Atlantic, is rarely taken in less than 100 fathoms, and its most striking feature in life is the presence of large green eyes. The fins of *signatus* are proportionately smaller than in species of *Eulamia*, and *signatus* has a longer and more pointed snout than any other large, West Indian, carcharhinid shark.

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NEW SUBSPECIES OF BIRDS FROM SOUTHWESTERN ASIA

BY WALTER KOELZ¹

During the working out of my collections from Iran, Afghanistan, and India, the following new subspecies were found. It seemed advisable to make these names available for the series of monographic revisions subtitled "Notes from the Walter Koelz collections."

***Ammoperdix griseogularis peraticus*, new subspecies**

TYPE: Adult female; Burchao Pass, Bend i Turkestan Range, western Afghanistan, south of Maimana; October 11, 1939; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Agrees in size with the nominate race. Adult female very similar to that of *A. g. ter-meuleni* from southwestern Persia and Iraq but paler and more vinaceous above and below; vermiculations on flanks fewer and finer. Adult females of the nominate race are much darker and grayer and more heavily vermiculated on the flanks than in either of the other subspecies. Adult males differ from those of *ter-meuleni* in being paler and more vinaceous above; the males of the nominate race are darker and grayer.

MEASUREMENTS OF THE TYPE: Wing, 131 mm.; tail, 63; bill from base of cere, 11. Measurements of three other adult females are: wing, 127, 129, 130; tail, 58.5, 59.5, 61; bill, 10, 10.5, 11. Four adult males measure: wing, 132, 133, 134.5, 135; tail, 61, 61, 61.5, 65.5; bill, 10, 11, 11, 11.

¹ In care of the American Consul, Bombay, India.

RANGE: Known from Burchao Pass and Qala Sarkari, Bend i Turkestan Range, western Afghanistan.

REMARKS: The name *bucharensis* Zarudny does not appear to apply to this population. Zarudny's original description (1911, Ornith. Monatsber., vol. 19, pp. 83-85) refers to a larger and less reddish bird.

***Streptopelia senegalensis kirmanensis*, new subspecies**

TYPE: Adult male; Kirman, Kirman, Iran; January 23, 1940; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Compared with *S. s. cambayensis* from Kathiawar (almost topotypical) and other areas in India the southern Iranian population has the wine color on lower plumage paler and tinged with brownish which does not extend down to the white abdomen; the rufous tips to the feathers on the sides of the neck and throat and the wing coverts are much paler.

MEASUREMENTS OF THE TYPE: Wing, 133 mm.; tail, 119; ramphotheca, 7.

RANGE: Southern Persia and southern Afghanistan; birds from Kandahar (southeastern Afghanistan) tend towards *cambayensis*.

***Athene brama albida*, new subspecies**

TYPE: Adult male; Saadatabad, Kirman, Iran; December 22, 1939; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Differs from *brama* by the paler general coloration and by the much greater amount of white on the upper parts. In particular the spots on the crown, scapulars, and upper wing-coverts are larger; the spots on either web tend to enlarge and broaden into a bar.

MEASUREMENTS: Wing, male, 163 mm., 167, female, 160, 162; tail, male, 78, 82.5, female, 75, 79. Specimens from Baluchistan average smaller: wing, male, 154-164.5 (160.0), female, 157-160 (159.0); tail, male, 74-82 (79.0), female, 76-83 (78.2).

RANGE: Iran and Baluchistan, possibly also Sind and other parts of northwestern India.

REMARKS: Birds from Baluchistan are in color close to Iran

birds but average smaller and have, on the average, longer tails. A bird from Sind (Hyderabad) agrees in color but has different proportions, namely, a very short tail.

Birds from Punjab (Lahore, Hissar district) are intermediate but closer to typical *brama*.

***Tyto alba microsticta*, new subspecies**

TYPE: Adult male, Jahrum, Fars, Iran, March 25, 1940; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Differs from *alba* by being a much paler bird. The black and white spots on the upper parts are smaller and narrower, with the black half reduced. The rufous-ochraceous portions of the plumage are very pale. The ruff that surrounds the facial disk is very pale, almost whitish; the gray areas on the upper parts are reduced in extent. Dark spots on under parts very small and reduced in number. Dark bars on tail and inner webs of primaries rather well developed.

MEASUREMENTS: Wing, male, 298 mm., 301, female, 292, 302, 308; tail, male, 118, 121, female, 117, 118, 119.

RANGE: Iran (Luristan and Fars).

***Glaucidium radiatum principum*, new subspecies**

TYPE: Adult male; Oria, Siriohi, Rajputana, western India; January 5, 1949; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Differs from *radiatum* by the greater width of the light bars on the upper parts. Bars on lower back and scapulars white, contrasting with the pale rufous bars of crown and lower back. Under parts lighter, dark bars reduced. White bars on tail broader. Dark bars dark gray rather than black.

MEASUREMENTS: Three males, wing, 127.5 mm., 128, 132; tail, 65, 68, 77.5.

RANGE: Known from Siriohi, but presumably of more widespread occurrence in the wooded ranges of Rajputana.

***Strix leptogrammica connectens*, new subspecies**

TYPE: Adult female; Amrasti, Bastar State, Central Provinces; March 27, 1949, W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Differs from *indranee* by the absence of rufous on throat and facial disk, size larger. Differs from *newarensis* by smaller size and a slight buff wash of the facial disk.

In the type there is no distinct blackish collar below the white throat patch. Dark bars of under parts broad, light bars of tail reduced.

MEASUREMENTS: Wing, 360 mm.; tail, 197.

RANGE: Known only from the unique type. Specimens that have been reported from Orissa (Goonsur) presumably also belong to this race.

***Strix ocellata grandis*, new subspecies**

TYPE: Adult male; Sasan, Junagadh, Kathiawar, western India; February 3, 1949; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Differs from *ocellata* by being of much larger size; similar in coloration, but averaging grayer above; size of black areas on back and nape reduced.

MEASUREMENTS: Wing, male, 360 mm., 372; against 333–338 (*ocellata*) and 338–346 (*griseszens*). Tail, male, 197, 203; female, 200, against 184–192 (*griseszens*) and 175–178 (*ocellata*).

RANGE: Known only from the Kathiawar Peninsula.

***Strix ocellata griseszens*, new subspecies**

TYPE: Adult male; Nichlaul (northeast of Gorakhpur), United Provinces, northern India; February 5, 1947; W. Koelz. Deposited in the American Museum of Natural History.

DIAGNOSIS: Differs from *ocellata* by slightly larger size and lighter coloration of the upper parts. Black bars on scapulars, wing, and tail feathers narrower; the black and white spots in the rufous area of the neck mostly white, while they are largely black in *ocellata*; rufous parts of plumage often paler.

Two specimens from Bheraghat (Central Provinces) agree in color with nominate *ocellata*, but are intermediate in size.

RANGE: Northern India (United Provinces and Bihar).

***Chrysophlegma flavinucha kumaonensis*, new species**

TYPE: Adult male; Kathgodam, Naini Tal District, United Provinces, India; April 8, 1948; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Similar to *P. f. flavinucha* from Sikkim but much larger and the green on the upper parts without the yellowish gloss.

MEASUREMENTS, IN MILLIMETERS

	Wing	Tail	Bill from Skull
<i>kumaonensis</i> (Kumaon)			
♂	181, 184	131, 136	45, 45
♀	182.5	134	44.5
<i>flavinucha</i> (Sikkim)			
♂	166, 170	114	41, 42
♀	172	115	39

RANGE: Northern United Provinces.

REMARKS: Gould's *flavinucha* was described from the Himalayas. His measurements indicate that he referred to the smaller eastern Himalayan birds. The type locality of *Picus flavinucha* Gould is hereby restricted to Darjeeling.

***Micropternus brachyurus kanarae*, new subspecies**

TYPE: Adult male; Londa, Belgaum District, Bombay, India; January 28, 1938; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Similar to *M. b. jerdonii* from Travancore and Ceylon but larger.

MEASUREMENTS OF *Micropternus brachyurus*, IN MILLIMETERS

	Wing	Tail	Bill from Skull
Type			
1 ♂	129	65	30
<i>kanarae</i> (Belgaum District)			
7 ♂	126-132 (128.3)	64-66 (64.7)	30-32 (30.5)
7 ♀	126-132 (129.6)	62-66 (64)	30-32 (30.9)
<i>kanarae</i> (S. Konkan and S. Kanara)			
From Whistler ^a			
4 ♂	127-130		28-31
5 ♀	126-129		28.5-31
<i>jerdonii</i> (Ceylon)			
4 ♂	118-120 (119)	57-61 (59)	28-30 (28.9)
2 ♀	118, 120	59, 61	28

^a 1934, Jour. Bombay Nat. Hist. Soc., vol. 37, p. 290.

jerdoni (Ceylon)From Whistler^a

9 ♂	115-122	58-62	26-30
6 ♀	116-122	56-64	25-28

jerdoni (Travancore)From Whistler^a

4 ♂	116 5-120 5	60 5-62 5	26-29
2 ♀	116 5, 120	62, 63	27-27.5

^a 1944, *Spolia Zeylanica*, vol. 23, p. 205.

RANGE: Southern Bombay (Kanara) to Mysore. Birds from Nilgiris, Malabar, and Shevaroy are intermediate between *kanarae* and *jerdoni*.

REMARKS: Malherbe's *jerdonii* cannot be used for this population since Whistler and Kinnear (1934, Jour. Bombay Nat. Hist. Soc., vol. 37, p. 291) show that the type came from Travancore, so that it applies to the more southern birds.

***Pericrocotus peregrinus dharmakumari*, new subspecies**

TYPE: Adult male; Jamwala, Junagarh, Kathiawar Peninsula, India; February 9, 1949; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Compared to *peregrinus*, the adult male has the throat blacker (like *malabaricus*); the flame-orange on breast is deeper; there is generally more white on abdomen; and in size it is smaller. Compared with *P. p. pallidus* it is darker and with flame-orange more extensive on under side.

In the adult female there is only just a trace of yellow on the flanks and sometimes on abdomen; in *P. p. peregrinus* there is more yellow. The female of *P. p. pallidus* is practically devoid of yellow on under side.

MEASUREMENTS OF *Pericrocotus peregrinus*, IN MILLIMETERS

	Wing	Tail	Bill from Skull
<i>dharmakumari</i>			
8 ♂	65-70 (67)	69-78 (72.7)	12 5-14 (13.3)
<i>dharmakumari</i> , type			
1 ♂	67	71	13
<i>peregrinus</i>			
(Punjab and United Provinces)			
25 ♂	68-74 (70.4)	74-83 (77.7)	13-14 (13.5)
		(18 specimens)	

RANGE: Southern Rajputana, Kathiawar Peninsula, and possibly also Kutch.

It gives me great pleasure to name this new race in honor of a keen naturalist, Sri K. S. Dharmakumarsinhji, the brother of the Maharao of Bhavanagar, Kathiawar.

***Lanius tephronotus lahulensis*, new subspecies**

TYPE: Adult male; Kolung, Lahul, Punjab, India; June 15, 1936; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Similar to *L. t. tephronotus*, but the back is dark gray, not slaty, and the rufous is more extensive, generally up to the hindmost scapulars.

MEASUREMENTS OF THE TYPE: Wing, 98 mm.; tail, 114; bill from skull, 22.

RANGE: Lahul and Spiti in the Punjab, and Suru Valley in Kashmir.

REMARKS: Whistler and Kinnear (1933, Jour. Bombay Nat. Hist. Soc., vol. 36, pp. 336-337) recognized this form, but transferred Vigors' *tephronotus* to it, leaving Hodgson's *nipalensis* for the real *tephronotus*, but this transfer of names is not justified (see Mayr, 1947, Jour. Bombay Nat. Hist. Soc., vol. 47, p. 126).

***Lanius schach kathiawarensis*, new subspecies**

TYPE: Adult male; Jamwala, Junagadh, Kathiawar Peninsula, India; February 12, 1949; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Similar to *L. s. erythronotus* and *L. s. caniceps*, but gray on back is paler than in either, and the rufous on the back is less extensive than in *L. s. erythronotus* but generally more than in *L. s. caniceps*.

MEASUREMENTS OF THE TYPE: Wing, 88 mm.; tail, 115; bill from base, 20.

RANGE: Rajputana, Kathiawar, and possibly also Sind.

REMARKS: This race evidently is confined to an area with the mean annual rainfall of about 30 inches or less.

***Garrulax ocellatus griseicauda*, new subspecies**

TYPE: Adult male; Wan, Garhwal, United Provinces, India; May 19, 1948; Rup Chand, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Compared with the birds from Sikkim and

Darjeeling (*G. o. ocellatus*) it has much more gray on the tail feathers, even the central tail feathers, which are without any gray in *ocellatus*, have some gray anterior to black near the tips; the spots on the upper back are almost pure white, while in *ocellatus* they are generally pale buff; the tail is a little longer in this race.

MEASUREMENTS OF THE TYPE: Wing, 135 mm.; tail, 163; bill from base, 33.

Four other birds (3 ♀, 1 ?) from the lower Himalayas, United Provinces, measure: wing, 132–136 mm.; tail, 160–164; bill from base, 31–32.

Five unsexed birds from Sikkim and Darjeeling measure: wing, 130–133 mm.; tail, 156–160; bill from skull, 30–32.

RANGE: Himalayas in the United Provinces.

REMARKS: Vigors described *Cinclosoma ocellatum* from the Himalayas. Baker (1922, The fauna of British India, vol. 2, p. 156) restricted the type locality to Darjeeling. Ticehurst and Whistler (1924, Ibis, ser. 11, vol. 6, p. 471) restricted all Vigors' type localities to the Simla-Almora area, but Baker's action must stand for *ocellatum*, since until recently the species was unknown in the Himalayas west of Nepal.

***Prinia hodgsonii pallidior*, new subspecies**

TYPE: Adult male; Sihor, Kathiawar, India; January 25, 1949; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: In winter plumage similar to *P. h. rufula* from the lower Himalayas, but the upper side is brownish rufous and much paler, and the under side has a trace of rusty cream on the flanks.

MEASUREMENTS OF THE TYPE: Wing, 49 mm.; tail, 56; bill from skull, 13.

RANGE: Rajputana, Kathiawar, and possibly also Kutch.

***Parus lugubris kirmanensis*, new subspecies**

TYPE: Adult male; Dehibakri [Deh Bakri] in the Kuh i Jamal Bariz Range, west of Bam in southeastern Kirman, Iran; January 28, 1940; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Very similar to *P. l. dubius* from southern Iran

(Fars), southwestern Iran (Bakhtiari, Luristan), and Kermanshah in western Iran, but, in comparative plumage, darker and browner on the mantle. *P. l. anatoliae* from Asia Minor is distinctly darker and grayer on the back than *kirmanensis* and much darker than *dubius*.

MEASUREMENTS OF THE TYPE: Wing, 78 mm.; tail, 64; bill from skull, 14.

Measurements of 12 adult males (including the type of *P. l. kirmanensis*) taken from January 27 to February 13, 1940, at Dehibakri and vicinity are: wing, 75–78 mm. (76.5); tail, 57–64 (60.6); bill, 12.5–14 (13.2). Six adult females taken at the same time measure: wing, 71–76 mm. (74.1); tail, 57–61 (59.5); bill, 12.5–13.5 (13.0).

RANGE: The mountains of southeastern Kirman. The only specimens known so far are the present ones.

Sitta neumayer plumbea, new subspecies

TYPE: Adult male; Guragan, near Masghun, Kuh i Jamal Range, southwest of Bam, Kirman, southeastern Iran; February 10, 1940; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Differs very markedly from all other races of *Sitta neumayer* by having the whole of the under parts ashy gray, the throat and breast in the other races being whitish or creamy; chestnut of the lower belly and flanks more reduced, invaded by ashy gray; black eye stripe reduced and poorly developed as in *S. n. tschitscherini*.

MEASUREMENTS: Type, wing, 76 mm.; tail, 44; bill from skull, 22.5. Another adult male and two adult females taken at the same locality on February 9 and 10 measure: wing, male, 78, females, 75, 76; tail, male, 44, females, 42.5, 43; bill, male, 23, females, 22.5, 23.

RANGE: This remarkable new race is probably restricted to the Kirman Mountains. It is the easternmost representative of the species and is presumably separated from *S. n. tschitscherini*, its nearest neighbor, by a wide gap; the easternmost specimen of the latter in my collection comes from Niriz, Fars, more than 200 miles to the west.

Zosterops palpebrosa amabilis, new subspecies

TYPE: Adult male; Sasan, Junagarh, Kathiawar, India;

January 30, 1949; W. Koelz, collector. Deposited in the American Museum of Natural History.

DIAGNOSIS: Similar to *Z. p. egregeria* but with bright yellow forehead and brighter throat. Differs from *Z. p. occidentis* by its citrine, not olive green, upper parts and by the whiter flanks and abdomen.

MEASUREMENTS OF THE TYPE; Wing, 55 mm.; tail, 38; bill from skull, 13.

RANGE: Kathiawar Peninsula.

REMARKS: This is an isolated population of arid Kathiawar.

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NOTES ON BIRDS OF SOUTHEASTERN PAPUA

BY E. THOMAS GILLIARD

This report is based on a collection obtained by the author in southern Papua in 1948 while making field studies for a Rouna Falls habitat group for Whitney Memorial Hall in the American Museum. Of 144 species observed, 134 were collected, comprising some 450 scientific study skins. A majority of the specimens came from the vicinity of the falls; the remainder were collected in the Owen Stanley Mountains, in lowland swamps and savannas behind Port Moresby, and on either side of this area in the vicinity of the native villages of Motumotu on the lower Brown River and Tupusiele on the coast near Bootless Bay.

I am very much indebted to Dr. John T. Zimmer and Dr. Ernst Mayr for assistance and advice during the preparation of these notes.

Full synonymies are easily obtainable from Mayr's "List of New Guinea birds" (1941, published by the American Museum of Natural History). The sequence of species given by Mayr is followed herein.

Species that I observed but failed to collect are indicated by asterisks.

Names of colors are capitalized when direct comparison has been made with Ridgway's "Color standards and color nomenclature."

ITINERARY

Following a flight from Manila via the Moluccas and Australia, I arrived at Jackson Airfield, 7 miles north of Port Moresby,

the morning of February 7, 1948. On the eighth my friend Owen MacNeill introduced me to Mr. T. L. Sefton of Koitaki plantation who most generously assigned to me five of his most trusted natives.

During a 50-mile drive to and from Koitaki we followed the Rouna road which, after crossing some low coastal hills, leads northeast for 10 miles through a flood plain choked with kunai grass and decorated with spaced-out eucalyptus trees. The road, which is subjected to intense water erosion on its upper reaches, climbs along the eastern flank of the Laloki River Valley between two massive, finger-like escarpments marking the western extremities of the Astrolabe Mountains. At an altitude of about 500 feet the valley becomes steep, and thereafter, until the Koitaki plateau is reached, it follows a tortuous, zigzag route across boulder-strewn talus slopes until it gains the summit of Warirata escarpment by way of a ledge above the cataract of Rouna Falls.

The brief reconnaissance that I was able to make during the course of this trip confirmed the earlier advice of Dr. John T. Zimmer and Dr. George H. H. Tate to the effect that I would find one of the most spectacular of Papuan terrain features in the upper Laloki canyon. The falls were selected forthwith as the locale for the habitat group, the immediate setting for which turned out to be an oft-frequented ledge known to countless soldiers, sailors, and airmen who were based in the Port Moresby region during the late war.

With great thoughtfulness, His Honor Colonel J. K. Murray, Administrator of British New Guinea, called me to his office on Monday, February 9, and immediately laid out a schedule which resulted in my obtaining all necessary credentials and instructions in a remarkably short time.

Preparations having been completed by the evening of the tenth, Mr. Owen MacNeill, to whom I am deeply indebted for many kindnesses, loaded his "jeep" with some of my expedition equipment, and the following morning we drove the 22 miles to Rouna Pass. There MacNeill placed an excellent little house at my disposal, one of three constructed at that place for the Red Cross during the war, which became my permanent base of operations. During my several absences Mr. J. B. Howard, a road engineer who lived near-by, performed the valuable service of watching over my men, materials, and specimens.

From February 12 to 26 I collected steadily in this region, devoting my efforts largely to the habitat group studies, but also to the training of my men, Mari-Uri, Arua-Maia, Asi-Manuo, Yai-Kakia, and Someri-Obui, all of whom had arrived from Koitaki on schedule the evening of the twelfth. Birds were scarce and difficult to collect on the broken slopes. Our camp was located about halfway down the east wall of the Laloki River chasm in a notch in the side of Warirata escarpment, the plateau of which terminated in high cliffs directly overhead to the east. To the west, on the far side of the imposing Laloki River gorge, rose the dense talus slopes of Hombron escarpment. These were crowned with 200-foot cliffs resembling the palisades of the lower Hudson River.

Rouna Falls is some 70 feet wide at its brink. The waters of the Laloki plunge about 250 to 300 feet in a nearly vertical drop to a great pool lined with a rich verdure of trees, moss, lichens, and orchids. Plans were afoot to harness the falls, but at the time of my visit no actual work had been begun.

On the afternoon of February 26 I began a trek into the Owen Stanley Mountains, guided by Mr. J. W. Derbyshire, Squire of Illolo, the innermost plantation behind Port Moresby. Derbyshire, who is one of the leading authorities on the Owen Stanleys, made this trip possible by contributing native carriers and his own valuable time.

The road to Illolo from Rouna Pass is treacherous and often impassable except to four-wheel-drive vehicles. Initially it climbs upward to the top of a broad rolling plateau through which the upper Laloki winds placidly. At an altitude of some 2000 feet it follows little ridges to the Laloki Bridge, a narrow concrete structure built during the war. Near-by stands a simple stone monument marking the terminus of the infamous Kokoda "Track." (All trails and poor "jeep" roads are known as tracks in New Guinea.) This track, which leads over the formidable Owen Stanley Range to Buna on the northern coast of eastern New Guinea, consists of a narrow footpath which in places is so steep as to be virtually unclimbable except on all fours or with the aid of a rope. It crosses innumerable streams, a number of rivers, and literally hundreds of ridges which quite frequently lie athwart the trail. During the war a "jeep" track was pushed through to a spot called Ower's Camp on the south side of the Goldie River, some 20 miles by trail beyond the

present location of the Kokoda monument. Beyond that point and onward to the far side of the Owen Stanleys travel is and has always been by foot. I emphasize this because of a recent error appearing several times in an otherwise excellent report by Robert G. Bowman, entitled "Prospects for settlement in northeastern New Guinea,"¹ in which the author states that during the recent war an all-weather highway was constructed across the Owen Stanley Range from Port Moresby to Buna on the northern coast.

Today the road terminates at Illolo some 6 miles north of the monument after passing through patches of high, open casuarina and mixed broad-leaf forest. In the main, however, it is bordered by large fields of kunai grass interspersed with thickets and second-growth forest. Several human habitations lie within sight of the road. One of these is the McDonald rubber plantation and another is an extensive tract farmed by members of a prospering Seventh Day Adventist Mission. A cluster of native houses is situated near the Laloki Bridge and, half a mile west of them, a rough track leads southeast to the southernmost bluffs of the Hombron escarpment at Yamagi lookout. There one comes upon a remarkable panorama extending from the high peaks of the Astrolabes to the east, across the south coast of Papua from Tupusiele village, Bootless Bay, Port Moresby Harbor, to Kairuka Bay far to the west. Visible from here are Waigani Swamp, both Big and Little Mt. Lawes, the immense forests of lower Brown River, and the entire course of the lower Laloki River. And, on clear days, the peaks of Mt. Victoria can be seen through the spaced-out trees of the grassy escarpment to the northeast (azimuth: 25 degrees).

Our party of 17 men moved inland to Ower's Camp high on the south flank of the Goldie River on February 28 and thence to Uberi village on the north bank of that river on March 1. With sufficient manpower to carry the "jeep" out of difficulties on occasion, we chose to drive over the abandoned road to its former terminus at Ower's Camp, crossing three rotting bridges en route. This camp, which is some 8 miles north of Illolo, consisted of several dilapidated houses situated in a large clearing in luxuriant rain forest containing a thick understory of tree ferns and much wild life. It is 1890 feet above the sea and about 40 miles by road from the coast and, with some improvements to the bridges, could be made to serve as an excellent zoological

¹ 1948, State Univ. Iowa Studies in Nat. Hist., vol. 19, no. 1.

collecting station for some future expedition. Uberi village (1205 feet) lies north of the Goldie, perhaps 4 miles distant from Ower's Camp and 225 feet above the river. It consisted of six native houses, a few gardens, and an orchard, all situated in a small clearing in high valley forest. Just to the north of the village there stood a tall buttress of black cliffs which comprised a portion of Imiti Ridge. At this station we were provided with a simply constructed but very satisfactory rest house by the village councillor, Mr. Iobu. Each village along the track is equipped with a similar house for transients and, whenever we stopped in one of them, both the village police boy and the village councillor treated us with courtesy.

Birds were collected en route, and specimens were prepared each evening. Sometimes the finished specimens were left behind in the rest houses to dry. All were safely retrieved on our trip out.

We left Uberi at 8:45 A.M. March 2 for Ioribaiwa village 55 miles inland, reaching our destination at 5 P.M. The trail led steeply upward through high forest to the grass-covered, knife-like crest of Imiti Ridge at 2400 feet and from there descended very abruptly into the matted Faure River basin where we had to cross the Faure no fewer than eight times. The fords, averaging 15 to 30 feet in width, are impassable at flood stage. Ioribaiwa (2240 feet) consisted of five crude houses, a number of native gardens, and, again, we found a series of black signal cliffs rising near-by. Our objective, Mt. Maguli, was visible to the east across intervening ridges. Many fox holes, scarred trees, and blasted caves in the cliffs overhead attested to severe jungle warfare in the vicinity of this village.

At 9:40 A.M. March 3 we left Ioribaiwa, bound for the highest point on the Kokoda Track between the south coast and the trail immediately below the gap in the Central Range. This destination, which we reached at 5 P.M., was in a low pass at 4200 feet on the northwestern portion of a long, whale-backed ridge leading to the summit of Mt. Maguli. To the north the trail descended to the broad valley of the upper Brown River, and forded it at an altitude of about 1000 feet in the vicinity of the village of Narao, a point some two hours distant from the pass in which we established our subtropical camp.

Immediately upon our departure from Ioribaiwa, we moved to the top of a ridge (2520 feet) which formed the southern perim-

eter of the Ofi River Valley, then dropped into the lowlands and proceeded to cross the Ofi and Emeuri rivers several times at altitudes ranging around 1675 feet. On the north flank of this valley the Kokoda Track rises steadily on the tops of a series of rounded ridges, ascending past the village of Bisitano (2465 feet) and "Jap Ladder" (3890 feet), to the aforementioned pass on Maguli Ridge. As might be surmised, "Jap Ladder" was a Japanese observation post built in a tree from which the southern coast of Papua, including Port Moresby Harbor, could be surveyed. The tree had been felled at the time of our visit.

The native name for Mt. Maguli is Mokoro-Onu and, curiously, after close study of early maps, I am convinced that this is the highland upon which Hunstein collected types and which he called "Horseshoe Mountain."

Our subtropical camp was occupied from March 2 to 7. A meager supply of water was obtained from bamboo shoots scattered through the woodlands below the summit. Surrounding us was a high, cathedral-like forest crowned with a continuous thick canopy.

The ridge of Mt. Maguli is about 6 miles long. It ascends gradually over a series of small saddles to a height of some 6000 feet. A narrow, little-used trail leads along its crest at least to a point 5000 feet high (the maximum elevation reached by us), crossing two sharp ridges which taper to a width of several feet. These are precipitously walled on the north side. The trees of the ridge are moderately cloaked with moss and decorated with bird's nest and stag-horn ferns, arboreal gardens, and some hanging vines. Below, the forest is rather open and easily penetrable to man. Although birds were relatively scarce, virtually every one taken was a subtropical species new to my collection.

Two miles southeast of our subtropical camp we found a promontory which commanded a magnificent panorama of the Central Range to the north with Mt. Victoria (13,363 feet) just left of center and the Kokoda Track gap above Myola to the right of center. Southward, at a distance of some 70 miles by trail and road and perhaps 25 as the crow flies, vast sections of the Papuan coast and the Coral Sea were visible through binoculars. Pigmy-like natives who visited us from the upper Brown River Valley identified this spot as "Orogirio." From it a view comprising 66 degrees of the Central Range was visible. It was by good fortune that I managed to secure photographs of the

highest mountain in Papua, Mt. Victoria, which is usually hidden in mist. Azimuths were immediately shot with a hand-held lensatic compass, and photographs were made from this, the focal point of our highland collecting ground. The former were as follows: Kokoda Track Gap near Myola, 19 degrees; high west peak of Mt. Victoria (Orira-ageva in Koiari), 245 degrees; high east peak of Mt. Victoria (Yic in Koiari), 250 degrees; Mt. Maguli peak through trees, 144 degrees.

On what appeared to be the lower south face of Mt. Victoria two waterfalls were observed. I estimated them to be located between the altitudes of 5500 and 6000 feet. One at an azimuth of 247 degrees was a wide short falls perhaps 200 feet high; the other was a spectacular ribbon falls with a drop of between 400 and 600 feet.

Birds of Paradise were common in the forests of Mt. Maguli but, with the exception of the Blue Bird (*Paradisaea r. rudolphi*), were difficult to obtain.

Quite unexpectedly Derbyshire, who made a two-day trek into the Brown River Valley (March 3 and 4), decided to take us out to Ioribaiwa on the seventh. On the eighth the trails were dry and by dint of a 15-hour march we retraced our path to Illolo plantation. Our visit to the Owen Stanleys had been made at the height of the wet season during an abnormally dry period. Each of the more than a dozen river crossings was a threat to our operation.

I worked in the vicinity of Rouna Falls with occasional collecting trips to the savannas behind Port Moresby and around Koitaki plantation between March 10 and 19. On the twentieth I moved my party to the village of Tupusiele on the east coast of Bootless Bay. We managed to drive our "jeep" the 30 miles from Rouna by way of the Rouna Road and a spur track which extends to Bootless Bay in the vicinity of the Whitbourne and Chapman plantations; beyond that point we drove through savannas, swamps, over salt pans, through rivers, and along the beach, finally reaching the village at dusk. This picturesque spot was inhabited by about 80 Motoan families who had erected some 60 houses on stilts over the waters of a large lagoon. Many tropical species were added to our collection at this station, particularly birds of the mangroves and beach. On March 25 and 26 we drove about 35 miles northwest, much of the distance over a long-unused Bren-gun track leading to Motumotu, a tiny

village of some five huts located on the lower Brown River. Unlike the hot dry terrain in the Tupusiele region, we found here a broad belt of tall virgin tropical forest which bordered the river in a band not less than 15 miles wide. Before reaching this forest we passed through a large unpopulated section of low, open savanna containing an assortment of spaced-out trees, clusters of bushes, and immense areas of swamp. Tracks of an introduced species of deer were observed here, and wallabies of two species were abundant. One of the latter was found in the river forests which contained a wealth of bird and mammal life. At Motumotu we collected our only examples of many tropical species, including the Twelve-wired Bird of Paradise (*Seleucidés ignotus ignotus*), Red-bellied Pitta (*Pitta sordida novaeguianae*), the Two-wattled Cassowary (*Casuarius c. sclaterii*), and the Crowned Pigeon (*Goura s. scheepmakeri*). We also obtained a wild pig and a species of large cuscus. This mosquito-plagued region abounded with fruit bats and reptiles and contained large populations of both the Two-wattled Cassowary and the Crowned Pigeon. The latter was missing from all other areas visited, and the former had been largely extirpated in all other lowland areas examined.

The 10 or so residents of little Motumotu were a sickly lot. Virtually everyone seemed to have malaria, the village councillor had a crippled hand, another man complained of excruciating pain in his kidneys, and, curiously, one of the few children we saw had a large scar with a bulging, pear-like appendage across his abdomen. We were informed that a pet cassowary, raised from a chick in the village, had done this damage with a single kick more than a year previously.

On March 31 I moved over the rough wet track to the "Nine Mile Quarry" behind Port Moresby, recrossing three large streams in the Brown River forest en route. The initial 15 miles of this trail cannot be followed except on foot or in a "jeep" equipped with four chains and with five men to push the vehicle out of deep draws and along sandy river bottoms when necessary, which is often.

Thereafter, until my departure for Australia on April 11, I worked in the Port Moresby lowlands and in the Rouna region, with one exception. On the fourth and fifth of April, in company with three Australians who had frequently assisted me in collecting birds around my lowland camps, William Lamont,

William Berlin, and John Hesschen, we tried to return to Motu-motu to obtain a skin of the King Bird of Paradise. Flash floods trapped us, however, and after a wet night in the swamps we made our exit.

WEATHER NOTES

The Rouna Falls area, although only 22 miles from Port Moresby and 1000 feet above the sea, is situated in a different meteorological zone. It lies perhaps a mile north of the hot, dry coastal band which envelops northern Australia, the Torres Strait, and Papua in the Port Moresby region, and consequently is subject to the seasonal rains of the interior. During the latter half of February these appear three to four afternoons per week, and often at night, in the form of short, violent rain squalls preceded by low mist.

During this period early morning temperatures ranged between 68° and 71° F., early afternoon temperatures between 76° and 80°, and late evening temperatures between 71° and 75°. In mid-March, during a period of 10 days, considerably less rain was experienced at Rouna Falls, although temperatures remained similar. Readings made at that time between 11 P.M. and midnight ranged between 67° and 72°.

At the Mt. Maguli camp (4200 feet), in an abnormally dry period in the first week of March, early morning temperatures ranged between 63° and 65°, late evening temperatures between 62° and 64°, and the highest reading obtained was 67° recorded both at 5 P.M. and 7 P.M. the evenings of March 5 and 6.

During March 21 to 25 at Tupusiele on the coast near Bootless Bay no rain fell, and a water shortage was sorely trying the ingenuity of the village fathers. Early morning temperatures ranged between 77° and 79°, shooting upward to 80° to 85° in the early afternoon and dropping to the low eighties in the evening.

Our Brown River camp near Motumotu village, perhaps 100 feet above sea level, was situated in a luxuriant high forest. We found this spot comparatively cool but oppressively damp in late March. Almost invariably heavy rains fell in the afternoon, often inundating the forest floor to a depth of from 2 to 6 inches. The 5 A.M. to 7 A.M. temperatures ranged between 71° and 75°, and the late evening temperatures ranged between 74° and 77°.

ANNOTATED LIST

Casuarius casuarius sclaterii Salvadori

Motumotu: One female.

Apparently common throughout the original tropical forests of the lower Brown River Valley in the vicinity of the village of Motumotu. In this area I flushed an adult at mid-day in deep forest and observed many tracks in silt fans of the recently flooded jungle and along the banks of small streams.

Very uncommon or extirpated elsewhere in the lowlands of the Port Moresby region. Between Uberi on the upper Goldie River and Narao on the upper Brown natives called my attention to a deep resonant honking which they attributed to this species. In each instance the sound came from the depths of original forest far below us. The frequency of these calls indicated that the Cassowary is common in the southern foothills of the Owen Stanley Mountains.

***Podiceps novaehollandiae** Stephens

Common on open fresh-water ponds near the coast, particularly in the Waigani Swamp area where I observed several small flocks, one of which was in company with five examples of *Anas superciliosa rogersi*.

Phalacrocorax melanoleucos melanoleucos (Vieillot)

Laloki River near Rouna: Two males; streams behind Tupusiele: one male, one female.

Fairly common although thinly distributed along the margins of streams and small rivers between the coast and 2200 feet. Near the Kokoda Track monument a single bird was frequently observed perching on the tip of a high dead tree about 50 feet from the Laloki River. Its perch and large portions of the tree were heavily whitewashed with guano, indicating frequent and continuous usage.

PERISHABLE COLORS: Bill and gape Wax Yellow, the latter with a broad black culmen. Legs, toes, and webs black. Iris grayish.

Anhinga rufa papua Rand

Laloki River near Rouna: One female, 1200 feet.

Common in the Waigani Swamp region. Rather uncommon along inland streams and rivers up to an altitude of about 2000 feet.

PERISHABLE COLORS: Maxilla Olive Yellow, with a broad Light Yellowish Olive culmen; mandible and gape a little paler than Lemon Chrome. Throat somewhat more vinaceous than Pinard Yellow. Lores like culmen. Legs pale bluish gray, becoming dusky gray on joints; nails gray with dusky tops and black tips; pads buffy gray. Iris Orange Chrome.

****Fregata ariel ariel* (Gray)**

Uncommon. I observed three birds on March 22 at Tupusiele flying north along the coast at a height of about 200 feet.

***Butorides striatus littleri* Mathews**

Tupusiele: One male.

****Cosmerodius albus modestus* (Gray)**

Observed in the Waigani Swamp region.

****Xenorhynchus asiaticus australis* (Shaw)**

Large storks were observed on several occasions flying southwest high over the Rouna region.

***Dendrocygna guttata* Schlegel**

Lower Brown River forests in the vicinity of Motumotu: One male, three females, four female juveniles.

Common. We came on an adult with eight or more young in the deep wet forest of the lower Brown Valley. The flock was feeding on the forest floor in heavy rain at least a quarter of a mile from the nearest stream. Four of the downy young were collected.

***Anas superciliosa rogersi* Mathews**

Vicinity of Tupusiele: One female.

Common in small flocks on the waters of Waigani Swamp and on stagnant ponds near Tupusiele. See annotations under *Podiceps novaehollandiae*.

****Milvus migrans affinis* Gould**

Not uncommon in the open lowlands. Usually found soaring

low over grasslands in the vicinity of Jackson Airfield 7 miles north of Port Moresby. Not observed elsewhere.

****Haliastur indus girrenera* (Vieillot)**

A pair of Red-backed Sea Eagles inhabited Rouna gorge just below the falls. They were to be seen at all hours of the day soaring over the deep forests of the talus slopes or over the swiftly flowing waters of the Laloki River. On four occasions in February I found this eagle perching on a high limb immediately below the crest of the Rouna road pass. A second pair apparently inhabited the forested region near the confluence of Sapphire Creek and the Laloki River at an altitude of about 500 feet.

This species exhibits a marked preference for inland forests in the vicinity of fresh water, at least during the months of February and March.

***Accipiter novaehollandiae leucosomus* (Sharpe)**

Koitaki: One male.

Infrequently observed perched on high dead trees overlooking the rolling grasslands along the Rouna-Koitaki road.

***Accipiter fasciatus polycryptus* Rothschild and Hartert**

Below Rouna, 500 feet: One female; Rouna, one female; Koitaki, one female. These specimens may be considered toptotypical of *polycryptus* which is based on a specimen from the Sogeri district.

During February the most common hawk of rolling kunai grasslands with spaced-out eucalyptus trees. Frequently observed perching solitarily on low living trees along the road extending between the "Nine Mile Quarry" and Koitaki plantation.

****Pandion haliaetus melvillensis* Mathews**

Observed once in flight over the Tupusiele lagoon, March 23, 1948.

***Falco peregrinus ernesti* Sharpe**

Hombron bluff: One female.

Uncommon. The only example observed was collected from the top of a dead tree on the summit of the Rouna palisades.

***Falco severus papuanus* Meyer and Wiglesworth**

South bank of the Goldie River at Ower's Camp: One male, 2100 feet.

Uncommon. One specimen was observed and collected on the edge of original high tropical forest bordering the Kokoda Track.

***Ieracidae berigora novaeguineae* Meyer**

Rouna: One male.

***Megapodius freycinet duperryi* Lesson and Garnot**

Vicinity of Tupusiele: One male, two females; lower Brown River forests: one female.

Fairly common in the lowlands. Unused nest mounds were found within 150 feet of the coast at Bootless Bay in stunted second-growth forest and in an orchard, also on level areas in open portions of original forest in the lower Brown River Valley. Birds were observed feeding in deep shade along the inner edge of high mangrove swamps east of Tupusiele village. No trace of this species was found above an altitude of 300 feet.

On March 24, Mr. Archibald Whitbourne of Bootless Bay guided me to two abandoned nests, one of which was 40 feet in diameter and about 5 feet high. He informed me that this nest was at least 40 years old and had not been used for some 30 years. His estimates were based on the fact that the nest in question is recorded in a survey made in 1908. In 1918 when Whitbourne purchased the property he found the nest to be located exactly as indicated in the original survey. It has not been used since that date and, according to Whitbourne, has decreased considerably in height and diameter, yet it remains as a prominent terrain feature in the midst of a large flat area. All sign of debris has long since rotted away, and at the time of my visit the brown earth mound was planted in yams.

***Aepyodius arfakianus* (Salvadori)**

Horseshoe Mountain (=Mt. Maguli): One male, 4000 feet; one female, 4200 feet.

Not uncommon in the subtropical rain forests of the southern flank of the Owen Stanley Mountains.

PERISHABLE COLORS: Sides of face pale bluish gray washed

with Apple Green between subloral and subauricular areas. Lores like face. Comb vinaceous. Throat whitish with a pale blue cast except on flat wattle at lower edge, which is dark gray with edges and central stripe Deep Vinaceous. Bill Tawny-Olive, more yellow below, becoming deeper brown, more Saccardo's Umber, on sides and basal half of maxilla, particularly on the culmen. Naked auricular openings pale slate with a pale grayish pink fan extending to the rear. Legs Tawny Olive, becoming darker, more Saccardo's Umber, on anterior scutes and on the dorsal scutes of the toes. Nails dull grayish brown. Iris a little browner than Honey Yellow.

****Synoicus ypsilophorus plumbeus* Salvadori**

Apparently a very uncommon inhabitant of the lowland grasslands in the vicinity of Port Moresby. My only observation is of a bird which flushed in front of a "jeep," flew about 30 feet, and then plunged into tall grass. Three men ran to the spot and the bird flushed again, this time to dive into grass 10 feet distant. Apparently this species finds refuge by running or burrowing under grass rather than by taking flight, except under very unusual conditions.

***Lobibyx miles* (Boddaert)**

Near junction of Sapphire Creek and Laloki River: One male, two females (?), February 17-18, 400 feet.

Common in cultivated and grazing areas of the lowlands, particularly in the vicinity of water holes. Two specimens were observed in shallow brackish waters bordering large salt pans near Bootless Bay on the coast, and three were observed among grazing cattle in the uplands of Koitaki plantation (1800 feet) in late February.

***Pluvialis dominica fulva* (Gmelin)**

Koitaki: Two females, February 17-18, 2100 feet; Tupusiele: one male, March 23.

Common on the upland pasture lands of Koitaki plantation throughout February and March. Not uncommon along the coast near Bootless Bay in late March. Usually in small flocks.

***Charadrius dubius papuanus* Mayr**

Lower Brown River: One male, 300 feet.

Three birds were observed feeding on small rocks bordering the lower Brown River, March 27.

***Numenius phaeopus variegatus* (Scopoli)**

Tupusiele: One male, March 22.

Brought in by a native collector.

***Limosa lapponica novaezealandiae* Gray**

Tupusiele: One male, March 23.

Brought in by a native collector.

****Actitis hypoleucos* (Linnaeus)**

Common along the coast at Port Moresby and Tupusiele during March.

***Ptilinopus coronulatus coronulatus* G. R. Gray**

Rouna: One female, one (?).

Common in the canopy of the original talus forest of Rouna canyon where it was encountered on exposed perches of the forest edge at dusk. Usually in pairs.

***Ptilinopus iozonus finschi* Mayr**

Little Mt. Lawes: Two males; vicinity of Port Moresby: two females; Rouna: one female, 2000 feet; lower Brown River forests: one female

Common in the crowns of spaced-out trees near water but difficult to detect because of its habit of sitting quietly in dense clusters of leaves. Usually in small flocks.

***Ptilinopus rivoli bellus* Sclater**

Rouna: One female, 1000 feet.

***Megaloprepia magnifica poliura* Salvadori**

Rouna: Two males; lower Brown River forests: three males.

Fairly common on the forested slopes of Rouna canyon, in the original forests of the lower Brown River, and in woodlands bordering the Kokoda Track south of Ower's Camp on the Goldie River; also observed in the open lowland forests behind Tupusiele village. Usually in small flocks.

PERISHABLE COLORS: Bill Primuline Yellow, becoming some-

what more citrine on outer half. Skin around eye a little brighter than Lumiere Green.

***Ducula spilorrhoa melvillensis* (Mathews)**

Tupusiele: Two males, one male immature.

***Ducula pinon pinon* (Quoy and Gaimard)**

Lower Brown River forests: One female.

Taken by a native hunter.

***Ducula rufigaster uropygialis* Stresemann and Paludan**

Uberi, Goldie River: One male, 1000 feet.

Apparently uncommon in the canopy of original tropical forest. This specimen was taken near the Kokoda Track ford.

***Columba vitiensis halmagei* (Bonaparte)**

Horseshoe Mountain (= Mt. Maguli): One male, 4300 feet.

Taken by a native hunter.

***Macropygia amboinensis cinereiceps* Tristram**

Rouna: One male (?), one female, one female immature, one (?).

Common in the middle and lower tiers of thick forests bordering Rouna canyon. Also found in forest-edge trees where on several occasions I was surprised to discover it perching quietly and motionless 20 to 30 feet overhead despite my noisy chopping. Usually solitary during February and March.

PERISHABLE COLORS: Bill a little more vinaceous than Mahogany Red, paler on basal half of mandible and gape. Legs brighter than Dark Vinaceous Brown; nails dark slate. Skin around eye slate black. Iris composed of three concentric circles as follows: innermost, pale gray; median, black; outermost, Capucine Yellow.

***Geopelia humeralis gregalis* Bangs and Peters**

Tupusiele: Three males, two females.

Fairly common on sandy ground and in bushes of the open lowlands of the Bootless Bay region. Also found feeding on the ground in sunny areas amid semi-dry mangroves and along the edges of damp salt pans.

***Geopelia striata papua* Rand**

Seven miles east of Port Moresby: one (?), 200 feet; Jackson Airfield, one male, 300 feet; below Rouna, one male, 500 feet; Tupusiele, one male, sea level; junction of Laloki River and Sapphire Creek, one male, 600 feet; foot of Little Mt. Lawes, one female, 300 feet; Rouna, one female, 1000 feet; Koitaki plantation, one female, 1800 feet.

Very common in open sandy areas amid the extensive grasslands bordering the coast in the vicinity of Port Moresby. Always in flocks. Uncommon above 700 feet.

***Chalcophaps indica chrysochlora* (Wagler)**

Rouna: One male, one female.

Not uncommon in semi-open forests of the Rouna talus slopes where it is usually found feeding on the ground in deep shade. Observed among the rubber trees of Koitaki plantation.

***Goura scheepmakeri scheepmakeri* Finsch**

Lower Brown River: Two males.

Taken by a native collector.

Quite common in the original forests of the lower Brown River Valley in the vicinity of the village of Motumotu. Apparently very rare or extirpated in other lowland areas adjacent to Port Moresby. Usually found in flocks of from three to seven feeding on the floor of deeply shaded high forest. When disturbed the flock walks stealthily or runs to concealment. If pressed too closely the birds disperse by flying to near-by limbs of the middle forest tier where, unfortunately, they can be easily shot. It is because of this characteristic that Crowned Pigeons are very difficult to protect, particularly as they are prized by local hunters and gourmets. Although as rigidly protected as the Birds of Paradise, the species appears to be doomed to extirpation in areas appropriated by modern man.

PERISHABLE COLORS: Bare skin showing through short feathers of the ocular ring and adjacent areas with subobsolete feathering slate black. Bill Slate Gray, becoming Gray (Gull Gray) on outer half. Interior of bill Slate Gray at edges, becoming pale Vinaceous-Gray on soft tissues. Tongue Pale Neutral Gray. Legs with large scutes Anthracene Purple, and broad intrascutal areas grayish white. Toes Spinel Pink × Rosolane Purple. Nails pale brownish gray. Iris Grenadine Red.

Trichoglossus haematodus micropteryx Stresemann

Rouna: Eight males, four females, one (?); Hombron Bluff: two females.

Very common in large flocks in isolated trees throughout the open grasslands. Frequently found feeding on the red berries of the umbrella tree.

Lorius lory erythrothorax Salvadori

Rouna: Five males, two females, one (?); Horseshoe Mountain (= Mt. Maguli): one male, 4400 feet.

Common in stunted forests of Rouna canyon and uncommon in high original forests bordering the Kokoda Track. One specimen taken in the Subtropical zone.

Charmosyna papou stellae Meyer

Horseshoe Mountain (= Mt. Maguli): One male, 3400 feet, one female, 4200 feet, one (?), 4300 feet.

Fairly common in the canopy of high tropical and low subtropical forests where it is usually encountered in small flocks.

PERISHABLE COLORS: Maxilla Scarlet Red, mandible and tip of maxilla paler, more Flame Scarlet. Legs Grenadine Red; talons black. Iris orange, with minute scarlet flecks.

Charmosyna pulchella bella (De Vis)

Horseshoe Mountain (= Mt. Maguli): Two males, 4000 and 4200 feet.

Common in the canopy of original subtropical forest. Always in small flocks.

Probosciger aterrimus goliath (Kuhl)

Lower Brown River: Two males, two females, one (?).

Common in the crown of original tropical forest bordering the lower Brown River. Unobserved elsewhere. Usually in noisy flocks of from two to six.

PERISHABLE COLORS: Skin of face and throat Warm Buff heavily stained with Eugenia Red, particularly at base of maxilla and on anterior malar areas; lores less reddish, more Warm Buff; throat without red. Iris a little darker than Mars Brown.

Cacatua galerita triton Temminck

Rouna: One male; lower Brown River near Motumotu: one male.

Common throughout the forested lowlands and in the foothills of the Owen Stanley Range to an altitude of about 3500 feet. This noisy, spectacular parrot is the most familiar bird of Rouna canyon where two or more birds are almost constantly to be seen in flight over the forest crown or perched on high sentinel trees of the steep talus slope.

PERISHABLE COLORS: Bill black; skin around eye pale bluish gray; a thin vinaceous eye ring. Legs and talons black.

Psitttrichas fulgidus (Lesson)

Horseshoe Mountain (= Mt. Maguli): One male, two females, 4200 feet.

Fairly common in the crown of subtropical forest. One specimen was observed near Ioribaiwa at an altitude of about 2000 feet.

PERISHABLE COLORS: Naked portions of face, throat, bill, legs, and talons black. Iris dark brown.

Larius roratus pectoralis (P. L. S. Müller)

Rouna: Two females; Tupusiele. one male immature, three females; Uberi: one male; Horseshoe Mountain (= Mt. Maguli): one female, 3000 feet.

Fairly common from sea level to 3000 feet in the upper limbs of large trees of the forest and forest edge.

PERISHABLE COLORS (FEMALE): Maxilla Flame Scarlet brightening to Grenadine Red on basal half, except at base which is narrowly Flame Scarlet; mandible black; eye ring Deep Mouse Gray; gape Salmon Orange. Legs Chaetura Drab; talons black; pads dark brownish buff. Iris Grenadine Red.

Geoffroyus geoffroyi aruensis (Gray)

Rouna: One male; Tupusiele: one female, one female immature.

A rather uncommon inhabitant of the lowland forest. The Rouna specimen was taken in the crown of deep talus forest from a flock of five.

PERISHABLE COLORS: Bill Scarlet, cere slate black, with a gray wash on the anterior edge; maxilla with a yellowish tip,

becoming dark gray on basal third; gape pale yellow. Feet and nails glossy black. Iris Buff Yellow.

***Alisterus chloropterus chloropterus* (Ramsay)**

Rouna: One male; foothills behind Port Moresby: one female; Uberi village, north bank of the Goldie River on the Kokoda Track: one male (type locality).

Uncommon in forested areas between Sapphire Creek and Uberi on the Kokoda Track. I observed it in high sentinel trees bordering the original forest.

PERISHABLE COLORS: Maxilla Coral Red, becoming Buffy Coral on outer half of culmen, tip and cutting edges black. Skin around eye dull smoke gray. Talons black. Iris a little brighter than Primuline Yellow.

***Psittacella madarászi madarászi* Meyer**

Horseshoe Mountain (= Mt. Maguli): One female, 4300 feet. Brought in by a native hunter. Nearly topotypical.

***Chalcites meyerii* (Salvadori)**

Rouna: One male.

Apparently uncommon. Our specimen was taken by a native hunter in thick talus forest above Rouna Falls.

PERISHABLE COLORS: Bill black. Eye ring Nopal Red. Legs Dark Gull Gray; talons black. Iris Liver Brown.

***Caliechthrus leucolophus* (Müller)**

Horseshoe Mountain (= Mt. Maguli): One male, 4300 feet; vicinity of Tupusiele: one female, 200 feet.

Very uncommon. Both specimens collected by natives.

***Centropus menbeki menbeki* Lesson**

Lower Brown River: One female, 150 feet.

Apparently uncommon. This specimen represents the only evidence obtained by us of this coucal in the Port Moresby region. It was taken by a native hunter in original tropical forest.

***Centropus phasianinus nigricans* (Salvadori)**

Rouna: Four males, five females; Koitaki: one female; Tupusiele: two males, one female.

Common inhabitant of kunai grassfields between sea level and 2400 feet. When flushed by a vehicle this bird frequently flies awkwardly to the top of a near-by bush where with head held high and wings drooping it often resembled a piece of rotted wood rather than a bird. In early February I observed a "pheasant" walking slowly across a grass clearing with its head downward and its wings partially open and nearly touching the ground. As soon as this bird disappeared in tall grass I jogged over the area thinking it would be a simple matter to flush the coucal, but I never saw it again. According to my Koiaris, this species crawls under matted grass and lies motionless when pursued.

Podargus papuensis Quoy and Gaimard

Lower Laloki River: One male, Rouna one male.

Probably fairly common but very secretive. Observed once at each of the localities listed above and on the top of Hombron escarpment (2100 feet). On two occasions the birds were solitary in large, isolated eucalyptus trees growing in kunai grassfields, and once I found them 50 yards apart in an open eucalyptus forest, the floor of which was thickly covered with low grass. The latter birds were observed at dusk in late March on Hombron. I was surprised to see them stand crow-like on high, nearly horizontal mid-limbs. I flushed each bird and watched it fly 30 to 50 yards and perch in similar fashion again. None were seen clinging to vertical surfaces and none were found lower than 35 feet from the ground. The specimen taken on the lower Laloki River edge at an altitude of 300 feet was shot by my hunting partner, William Lamont, in mid-afternoon. It was the only one observed except at dusk. I did not determine its diurnal resting position.

***Caprimulgus macrurus yorki Mathews**

Apparently rather uncommon during March and early April. Two birds were found sitting 400 yards apart on a gravel road near the lower Laloki River Bridge, March 29, at about 7 P.M. Their eyes reflected pale gold in the vehicular headlights.

***Chaetura caudacuta caudacuta (Latham)**

Observed February 16. See *Collocalia vanikorensis granti*.

***Collocalia esculenta esculenta* (Linnaeus)**

Rouna: One male, two females; Koitaki: one male.

Very common about cliffs, talus slope clearings, and water courses between 500 and 3000 feet in flocks of up to 15 birds. Abundant in the vicinity of Rouna Falls.

***Collocalia vanikorensis granti* Mayr**

Lowlands behind Port Moresby: Two males.

Fairly common. Collected from drones of 30 or more of several species near Jackson Airfield, February 16 and 21.

***Hemiprocne mystacea mystacea* (Lesson)**

Vicinity of Ower's Camp on the south bank of the Goldie River: One male, one female, 2100 feet.

Uncommon. My only observation was of four birds found occupying a long narrow clearing in original forest bordering the Kokoda Track. The birds repeatedly forayed over the clearing from established perches high in living trees

***Alcyone azurea lessonii* Cassin**

Rouna: One female.

Taken by a native collector.

***Syma torotoro meeki* Rothschild and Hartert**

Port Moresby region: One male; Little Mt. Lawes: one male; Rouna: one male, one female; Koitaki: one female; Ower's Camp: one male; Uberi on the north bank of the Goldie River: one female.

Fairly common in original and second-growth forest edge near grassfields. Usually found sitting motionless on exposed perches 4 to 25 feet above kunai grass. One specimen was taken from a perch 25 feet up in a vine-matted tree on the fringe of Uberi village in the original tropical forest of the Goldie River Valley.

PERISHABLE COLORS: Bill Cadmium Yellow; feet Deep Chrome; nails brownish black; Iris Brownish Olive.

***Melidora macrorhina macrorhina* (Lesson)**

Rouna: One female.

Uncommon. Brought in by a native collector.

***Dacelo leachii intermedia* Salvadori**

Rouna: Three males, one female, two (?); Tupusiele: one male, three females.

Very common in spaced-out eucalyptus trees of the kunai grasslands. Less common throughout the open forests and high mangroves. Not observed above 2800 feet and apparently absent from the dense tropical forests bordering the lower Brown River. During February and March usually found perching quietly on mid-limbs of the forest edge and in sentinel trees. During late March in the lowlands I was often greeted by a screeching din which lasted many minutes. In each instance the racket was caused by a pair of protesting Blue-winged Kookaburras.

Many residents of the Port Moresby region hold the erroneous belief that this bird was introduced from Australia. Although recognizing the pronounced vocal differences which exist between the New Guinea and the Australian races, they explain wryly that the Kookaburras found the Papuan climate so disagreeable that they could no longer utter their famous Jackass laugh.

PERISHABLE COLORS: Maxilla black, with profuse silvery scales; mandible bone white, becoming blackish on posterior sides and on most of outer third except tip; legs grayish olive; nails black.

***Sauromarptis gaudichaud* (Quoy and Gaimard)**

Imiti ridge above Uberi on the northern flank of the Goldie River. One female; lower Brown River forests: one female.

Not uncommon in the tropical forest where I once observed this species to perch for many minutes in the mid-limbs of a tall tree growing on the edge of the Kokoda Track in original hill forest.

***Halcyon macleayii elisabeth* (Heine)**

Rouna: Three females.

Probably fairly common in the deep forests bordering the Laloki River where I infrequently found it perching alone 8 to 16 feet from the ground.

PERISHABLE COLORS: Maxilla black, with a small black tip; mandible Zink Orange, becoming dusky on basal sides and Lemon Yellow on tip. Gape and soft skin at sides of maxilla Apricot Orange. Eye ring dark gray, becoming buff on anterior half.

Legs grayish buff; toes grayish yellow; pads Apricot Buff; nails dark gray. Lores a little paler than Ochraceous Buff. Iris dark purplish gray.

Halcyon macleayii macleayii

Tupusiele: One female, March 21.

Found in the high, semi-dry mangroves bordering Tupusiele lagoon.

***Halcyon sancta sancta* Vigors and Horsfield**

Tupusiele: One male, three females, March 20-22.

***Tanysiptera galatea minor* Salvadori and D'Albertis**

Rouna: One male, one female immature; lower Brown River forests: two females, one [female].

A fairly common inhabitant of the stunted talus slope forests bordering Rouna canyon, also the high forests bordering the lower Brown River. Found singly 4 to 18 feet up.

PERISHABLE COLORS: Maxilla black, with a tan tip; mandible Zink Orange, becoming dusky at basal sides and Lemon Yellow at tip. Skin at sides of maxilla and gape Apricot Orange. Eye ring dark gray, becoming buff on anterior half. Legs grayish buff, toes more yellowish; pads Apricot Buff; nails dark gray. Lores a little paler than Ochraceous Buff. Iris dark purplish gray.

***Merops ornatus* Latham**

Near confluence of Sapphire Creek and Laloki River: One male (?); top of Hombron escarpment: one male, two females; Little Mt. Lawes: one male; lower Brown River edge: one female.

In February rather uncommon in open grassy areas of the lowlands (100 to 500 feet) containing spaced-out trees. In March fairly common; in late March and early April common and for the first time seen in flocks of up to 20 flying over my Rouna camp (1100 feet), Hombron escarpment (2200 feet), and Koitaki (2500 feet). Always in open flocks. Fond of perching on wires along the Rouna-Port Moresby road and on high limbs of slender trees growing in grasslands. Unobserved above 2800 feet.

PERISHABLE COLORS: Bill, legs, and feet black.

***Eurystomus orientalis waigiouensis* Elliot**

Rouna: One male, two females; Ower's Camp, south bank of the Goldie River: one male; Uberi village in the Goldie River Valley: one female; Tupusiele village: one female.

A common solitary species of semi-open grasslands, trees of the forest edge, and semi-open woodland clearings, between sea level and 2800 feet. Most frequently observed sitting motionless for long periods on high, dead perches.

PERISHABLE COLORS: Bill Coral Red, the culmen pinkish on inner half and blackish on outer half. Feet Coral Red with black nails. Iris Mars Brown.

***Eurystomus orientalis pacificus* (Latham)**

Rouna: One male.

Shot from a dead tree bordering the Laloki River just above the falls, March 10. Apparently very uncommon and thinly distributed.

***Rhyticeros plicatus jungei* Mayr**

Rouna: One female; Horseshoe Mountain (= Mt. Maguli): one male; lower Brown River forests: two males.

Fairly common in pairs in the canopy of original tropical and subtropical forest. A fruit tree growing at 1900 feet in the thick forests of Rouna canyon near the falls was frequented daily during February and March by from two to six birds. Males and females were observed feeding together in the crown limbs.

To one unfamiliar with this hornbill its characteristic thrashing flight is startling. When the wind was right, I found it possible to follow by ear the flight paths of single birds 200 yards distant and to orient correctly their position as they landed in trees 50 yards away.

PERISHABLE COLORS (MALE): Eye ring deep vinaceous; skin around eye Light Squill Blue; throat and chin white, washed with Etain Blue, particularly on lower portions. Bill a little more buffy than Cartridge Buff, the maxilla with blackish brown slots which become lighter posteriorly to the rearmost slot which is more pinkish than Hydrangea Red. Posterior concavity of maxilla a little more pinkish than Dark Vinaceous. Basal quarter of maxilla and basal third of mandible deep Vinaceous Red.

Legs black with broad gray scute emarginations; talons black. Iris Scarlet Red with a fine concentric mid-line consisting of minute black flecks.

PERISHABLE COLORS (FEMALE): Bill bone white, becoming dark brown in the dorsal concavities of the casque, the rearmost of which is bordered posteriorly with a band of dull Orange Vinaceous; rear of mandible with an irregular subterminal black margin. Skin around eye Pale Windsor Blue, darkening to Clear Windsor Blue near eye ring; eye ring purplish black. Throat like skin around eye but more Pale Etain Blue, becoming whitish on anterior half and on malar areas; skin bordering gonydeal angle like that of posterior throat. Feet black, with pale gray intra-scutal margins; nails black; pads dull lemon yellow. Iris Pale Purplish Gray.

Pitta sordida novae-guineae Müller and Schlegel

Lower Brown River near Motumotu: One female and an

Koiari name: Oh-ro-u.

Apparently rather uncommon in the deep forests of the lower Brown River Valley where a single female was taken by a native collector, March 28. This secretive inhabitant of the jungle floor was observed by Mari-Uri as it rose from a sitting position in grass and leaves at the edge of original forest. After shooting the bird my collector examined the resting spot and discovered an egg lying on a dead leaf but no sign of a nest. This egg has a whitish lavender base color with medium large blotches of pale lead gray and pale grayish brown chiefly concentrated about the larger half; also a few reddish brown blotches scattered among the paler markings. Measurements of egg: 26.4 by 24.4 mm. Because of a break in the shell the latter measurement is approximate.

PERISHABLE COLORS (FEMALE): Bill black. Interior of mouth grayish vinaceous with a pale vinaceous tongue. Legs pale grayish brown. Iris near Dark Maroon-Purple.

Lalage sueurii tricolor (Swainson)

Seven miles east of Port Moresby: One male, February 21.

Not uncommon in the open lowlands among spaced-out eucalyptus trees and bushes.

Edolisoma tenuirostre mülleri Salvadori

Horseshoe Mountain (= Mt. Maguli): One male, one (?), 4200 feet.

Collected from the crown of original subtropical forest.

Coracina caeruleogrisea adamsoni Mayr and Rand

Horseshoe Mountain (= Mt. Maguli): One female, 4200 feet; one male, 3500 feet (near Ioribaiwa); Ower's Camp: one male, 2100 feet.

Fairly common in high tropical and subtropical forests where it is encountered in pairs or small flocks in the topmost foilage. On occasion this silent bird conceals itself by hopping into thick clusters of leaves and remaining motionless for a minute or more.

PERISHABLE COLORS: Legs and talons black, with vivid gray intra-scutal lines; pads bright citron yellow. Iris Seal Brown.

Coracina novaehollandiae melanops (Latham)

Rouna: One male, March 15; below Rouna: one male, March 13; 500 feet.

Uncommon. Observed four or five times in open lowland areas where it usually chose low perches in bushes or small trees growing amid fields of kunai grass.

Coracina papuensis angustifrons (Sharpe)

Below Rouna: One male, 500 feet; Little Mt. Lawes: one male; Hombron escarpment: one male; Tupusiele village: one male.

Common in the open lowlands where it was most frequently encountered 20 to 50 feet up in eucalyptus trees growing in high kunai grass along the Port Moresby-Rouna road. Usually in open flocks of two to five birds of the same or related species. Not observed above 2100 feet.

Pomatostomus isidori isidori (Lesson and Garnot)

Port Moresby region: Two males.

Brought in by native collectors.

Malurus alboscapulatus moretoni De Vis

Rouna: One male, one female.

Common in grassy areas containing bushes and spaced-out

trees; also in the edge of second-growth forest and in the vicinity of native villages. Observed between sea level and 2800 feet.

***Todopsis cyanocephala bonapartii* Gray**

Four miles east of Motumotu on the lower Brown River: One (?).

An uncommon inhabitant of swampy grassfields containing bushes, trees, and often a fringe of reeds. Not observed above an altitude of 200 feet.

***Cisticola exilis diminuta* Mathews**

Near Waigani Swamp: One male, March 29.

A fairly common but secretive inhabitant of lowland kunai grassfields.

***Sericornis papuensis papuensis* (De Vis)**

Horseshoe Mountain (= Mt. Maguli): One male, 4400 feet.

Not uncommon in the subtropical forests of Mt. Maguli where it was usually found 1 to 8 feet up in bushes or slender trees. Very inquisitive and wren-like. Alarm call: a long low rattle emitted while standing on small limbs or thin vertical shafts 10 to 40 feet distant.

***Phylloscopus trivirgatus giulianettii* (Salvadori)**

Ower's Camp, south bank of the Goldie River: One female, 2100 feet.

This nearly topotypical specimen was taken from the crown of original forest bordering the Kokoda Track.

***Peltops blainvillii* (Lesson and Garnot)**

Near Ioribaiwa on the Kokoda Track 50 miles by trail north-east of Port Moresby: One male, not below 1675 feet.

Apparently uncommon. Our only record is of a specimen collected by one of my hunters from the top of the forest bordering the Kokoda Track.

***Rhipidura hyperythra castaneothorax* Ramsay**

Lower Brown River Valley: One female, 300 feet.

Not uncommon in the middle tier and crown of original tropical forest.

Rhipidura albolimbata auricularis De Vis

Horseshoe Mountain (= Mt. Maguli): Two males, one (?), 4200 feet.

Common in basal half of subtropical rain forest. See *Climacteris placens meridionalis*.

Rhipidura rufiventris gularis Müller

Lowlands behind Port Moresby: One (?).

Brought in by a native.

Rhipidura leucophrys melaleuca (Quoy and Gaimard)

Jackson Airfield behind Port Moresby: One female; Hombron escarpment: one (?); Koitaki: one male, 1800 feet; Uberi village, Goldie River Valley: one male, 1000 feet; Tupusiele village: one male; lower Brown River Valley: one male.

Common in open sandy and grassy areas interspersed with scrub and small trees. Usually near fresh water. Often encountered on the edge of native clearings and about local homesteads where it perches on low branches and posts, and is frequently seen on the ground. Not observed above 2800 feet.

Monarcha alecto chalybeocephalus (Garnot)

Tupusiele: One male.

Brought in by a native collector.

Arses telescopthalmus henkei Meyer

Koitaki: One (?); lower Brown River: one [male].

Fairly common in the middle and top tiers of the luxuriant Brown River forest near the village of Motumotu where I found it traveling in company with *Rhipidura hyperythra castaneo-thorax*. Apparently it is fond of hunting for food on bark of the middle and upper limbs.

PERISHABLE COLORS: Bill light Ampero Blue, paler at tip. Legs dark bluish gray: nails black. Wattles around eye Phenyl Blue. Iris a little darker than Bistre.

Microeca leucophaea zimmeri Mayr and Rand

Seven miles east of Port Moresby: One male.

Taken from the middle limbs of a spaced-out eucalyptus forest growing amid high kunai grass.

***Microeca flavigaster terraereginae* Mathews**

Little Mt. Lawes: One male; Tupusiele: one female.

Common in the middle and top tiers of eucalyptus trees growing in the lowland kunai grass belt.

***Tregellasia leucops albifacies* (Sharpe)**

Ower's Camp, south bank of the Goldie River: One (?), 2100 feet.

Taken by a native collector.

***Rhagologus leucostigma obscurus* Rand**

Horseshoe Mountain (= Mt. Maguli): One male, 4300 feet. Taken from the crown of subtropical forest.

PERISHABLE COLORS: Legs, feet, and talons black; pads buffy yellow. Iris a little brighter than Hessian Brown.

***Pachycephala soror bartoni* Ogilvie-Grant**

Horseshoe Mountain (= Mt. Maguli): One male, 4500 feet; two females, 4200 feet.

Fairly common in the crown of subtropical rain forest, often in company with *Melidectes torquatus emilii*.

PERISHABLE COLORS: Bill black; legs and talons dark gray. Iris Ox-blood Red.

***Pachycephala griseiceps dubia* Ramsay**

Ower's Camp, south bank of the Goldie River: Two males, 2100 feet.

Taken by a native collector.

***Pachycephala modesta modesta* (De Vis)**

Horseshoe Mountain (= Mt. Maguli): Two males, 4200 feet.

Observed in the middle and upper portions of subtropical rain forest.

***Myiolestes megarhynchus despectus* (Rothschild and Hartert)**

Ower's Camp: One female, 2100 feet.

***Colluricincla harmonica tachycrypta* Rothschild and Hartert**

Hombron escarpment: One male.

***Pitohui dichrous monticola* Rothschild**

Rouna: Two males, 1000 feet; Uberi village, Goldie River Valley: one female, 1000 feet.

A rather secretive inhabitant of the thick forest edge bordering the Kokoda Track, where it was usually seen as a nervous shadow near the ground. Very difficult to see despite its shrill and oft-repeated whistle which is emitted whenever man approaches closely.

***Pitohui ferrugineus clarus* (Meyer)**

Rouna: One male, one (?); near Ioribaiwa: one male, 2200 feet; lower Brown River Valley: one female.

Observed in the middle tier and along the edge of the thick stunted forests of Rouna canyon.

***Artamus leucorhynchus leucopygialis* Gould**

Near Jackson Airfield behind Port Moresby: One male, one female; Tupusiele village: one male.

Abundant. Not observed above 800 feet. Always in distinct flocks of six to 12 or more which occupy selected areas in the semi-open lowlands containing a mixture of large and small spaced-out trees. Colony members begin gathering on specific roosting limbs about an hour before sunset, but all through the day they remain more or less together as they course about in search of flying insects. At night they cluster together in tight little knots on high, nearly horizontal limbs of isolated eucalyptus trees.

***Aplonis cantoroides* (Gray)**

Rouna: One female; Tupusiele village: one male.

Uncommon. A few birds were observed singly in the open lowlands.

***Mino dumontii dumontii* Lesson**

Rouna: Five males, two females.

Very common in all areas containing trees in any quantity. Not observed above 2800 feet. Always in large noisy flocks. The raucous chatter of this species is often heard both in the open grasslands and in the crown of original tropical forest. Usually found in the canopy of high trees.

PERISHABLE COLORS: Bill Cadmium Orange, yellower at base; skin of face and small wattles a little more orange than Capucine Yellow. Legs Cadmium Yellow. Iris bright Cadmium Yellow interspersed with rather large black flecks.

***Oriolus szalayi* (Madarász)**

Rouna: Three males, one female.

Found in the matted forests of Rouna canyon.

PERISHABLE COLORS: Bill Morocco Red. Legs Dark Quaker Drab; nails black. Iris Nopal Red.

***Sphecotheres vieilloti salvadorii* Sharpe**

Tupusiele: Two males, one female.

Apparently uncommon. These specimens comprise my only record of the species. They were taken with a single shotgun charge from a flock of 10 or more which gathered at dusk in an isolated, thickly leafed tree growing on the seaward edge of a large grassfield 30 feet from open water.

***Pomareopsis bruijni* (Salvadori)**

Goldie River Valley above Uberi village: Tail and abdomen feathers, 1500 feet.

Very uncommon. My only observation was of a pair seen on big conglomerate boulders in a narrow forest stream on March 8 at about 4 P.M. At a distance of some 40 yards they resembled large wagtails chiefly because of their nervous hopping and fluttering among the water-washed rocks. Following a minute of observation through glasses, I fired. Unfortunately my target fell into swiftly flowing water with the result that the distinctive feathers recorded above were all I could find of this rare Magpie-Lark.

***Cracticus cassicus cassicus* (Boddaert)**

Rouna: Two females; lower Brown River: one male.

Common along the lowland forest edge and in open areas containing spaced-out trees, boulders, and clumps of bushes. Usually in small flocks of from two to six which moved wave-like across the country, often in company with related species.

***Cracticus mentalis mentalis* Salvadori and D'Alberty**

Rouna: Two females; Koitaki: one (?).

Similar in habits to preceding species.

***Dicrurus hottentottus carbonarius* Bonaparte**

Rouna: Six males, one female; Uberi, Goldie River Valley: one male; Tupusiele: one (?); lower Brown River Valley: one male.

A common, solitary bird of the stunted forests bordering Rouna canyon where I found it most frequent well inside the forest in the middle tier of slender trees. Less common along the forest edge at Rouna, in the wet forests of the lower Brown River Valley, and about the coastal village of Tupusiele.

PERISHABLE COLORS: Bill and feet black. Iris Grenadine Red.

***Chaetorhynchus papuensis* Meyer**

Horseshoe Mountain (= Mt. Maguli): One male, 4300 feet; one female, 4400 feet.

Taken in subtropical rain forest.

***Corvus orru salvadorii* Finsch**

Rouna: One male, one female; near Port Moresby: one female; Jackson Airfield behind Port Moresby: one male; vicinity of Tupusiele village: One male, one female.

Very common in lowland savannas with spaced-out eucalyptus trees, particularly in the vicinity of refuse heaps near Jackson Airfield. Uncommon above 1000 feet and apparently unknown above 3000 feet. Usually in open flocks. Rarely solitary.

***Gymnocorvus tristis* (Lesson and Garnot)**

Rouna: One female, one female (?); lower Brown River near Motumotu: one male.

Very common between 500 and 2500 feet in heavily forested areas, particularly near cliffs and fresh water. Usually in large noisy flocks of from six to 10 which stream vociferously through the forest crown. Occasionally observed in the mid-limbs of large sentinel trees on the edge of native villages.

PERISHABLE COLORS: Bill bone white on outer half, pale vinaceous pink on inner half. Gape, lores, throat, skin above and below eye vinaceous pink; naked area behind eye pale vinaceous gray. Legs Baryta Yellow; talons blackish gray. Iris Light Amparo Blue.

***Manucodia ater subalter* Rothschild and Hartert**

Rouna: Two males, one female; Tupusiele village: one male.

An uncommon inhabitant of the stunted woodlands bordering Rouna canyon where I occasionally observed it in the forest canopy. On February 12 I found this manucode feeding on small berries in company with four or more females or immature males of *Paradisaea apoda salvadorii*. The mixed flock picked its way silently about in slender crown branches some 25 feet above a steep talus slope leading down to Rouna Falls.

PERISHABLE COLORS: Bill, legs, and toes black. Gape pale gray. Eye ring purplish black. Inside of bill dusky gray lightening inwardly to pale vinaceous gray. Tongue Gull Gray with a paler tip. Iris: in one specimen it appeared bright Cacao Brown, in another Acajou Red.

***Phonygamus keraudrenii purpureo-violaceus* Meyer**

Horseshoe Mountain (= Mt. Maguli): Two males, one female, 4200 to 4400 feet.

Taken in subtropical rain forest.

***Drepanornis albertisii cervinicauda* Sclater**

Near Uberi, Goldie River Valley: Two females, 1400 feet (?).

Shot by a native collector in high forest bordering the Kokoda Track.

***Parotia lawesi lawesi* Ramsay**

Horseshoe Mountain (= Mt. Maguli): One male, 4200 feet.

Taken by a native collector some 60 feet up in a cathedral-like forest on the north slope of Mt. Maguli.

PERISHABLE COLORS: Bill and gape blackish. Legs somewhat darker than Vandyke Brown; talons dark brown. Iris Martins Yellow.

***Lophorina superba minor* Ramsay**

Horseshoe Mountain (= Mt. Maguli): One male, 4300 feet.

Shot by a native collector in subtropical rain forest. This specimen was brought in alive and successfully photographed. In doing so I noted that the spectacular hood is usually carried inconspicuously along the back in two closed fans resembling folded insect wings. When aroused, the bird erected these plumes in the manner of an Indian headdress. At other times a flat, almost vertical fan was formed as the subject pointed its bill downward in apparent fury.

***Seleucidés ignotus ignotus* (Forster)**

Lower Brown River near Motumotu: One male, one female.

Not uncommon. Collected in the crown of luxuriant valley forest bordering the lower Brown River. In this area I observed a solitary male as it moved slowly along a richly decorated limb 80 feet up. It seemed to be feeding among the arboreal plants.

PERISHABLE COLORS (MALE): Bill black. Legs vinaceous near Rose Doree; talons brownish gray, becoming slate gray on outer halves. Hard internal parts of bill and outer surfaces of tongue black; soft internal tissues brilliant Mineral Green washed with Cobalt Blue. The brilliancy of the open mouth is accentuated by the dead black velvety feathers which surround it. This coloration is a secondary sexual character which doubtless is used in display. Iris Scarlet Red.

PERISHABLE COLORS (FEMALE): Like the male but with internal mouth parts Martins Yellow, not green as indicated. Iris Light Cadmium, not Scarlet Red. Legs somewhat more Buffy Gray, less Salmon.

****Cicinnurus regius rex* (Scopoli)**

Apparently quite uncommon. Despite extensive hunting I found no trace of this species. A male King Bird of Paradise is known to have been killed by a native near Sogeri plantation in 1947.

***Paradisaea apoda salvadorii* Mayr and Rand**

Rouna: Three male immatures, two females, one female (?), one (?); Koitaki: three males, near Ower's Camp, one male.

Very common in Rouna canyon where it fed in the upper portions of trees located well within the stunted forest. Flocks were infrequently seen streaming through the canopy on apparently well-defined arboreal trails near Koitaki plantation in semi-original woodlands and in the high original forests between Illolo and Ower's Camp. According to my natives, these wandering flocks were bound for "dancing trees" in the vicinity. I found no trace of this species below 800 feet, although it must occur in the lowland forest. Mr. Archibald Whitbourne (see p. 13) found it common in the lowlands during the years 1907-1909.

On February 22 at 3:45 P.M. I shot a solitary male in fresh plumage just north of Illolo on the Kokoda Track, 2500 feet. This bird had made a number of short flights along the course of

our march in an inquisitive manner resembling that of the Squirrel-tailed Cuckoo of South America. Adding to the illusion, its reddish flank plumes took on the appearance of a long rufous tail as it moved from one semi-concealed perch to another. No other adult males were discovered except during flocking hours. Females and immature males were regularly found feeding at any time of day in the Rouna forests where they seemed far to outnumber the males. At about 4 P.M., March 29, near Koitaki one of a small flock which I had been following performed briefly on a thin, nearly horizontal limb some 60 feet up in a tall, partially dead forest tree. The male opened and closed its wings as though getting ready to fly; then after a slight pause it repeated this movement quite rapidly, at the same time extending its flank plumes downward and outward until they touched the perch. After some 15 seconds of this action the bird jumped a short distance to one side and shortly thereafter flew out of sight in company with several others of the same species. The band appeared to be bound for a dancing tree. A mild rain storm was under way during the period of observation.

My usually well-informed native assistants believed that plumed birds were females or "Marys." When shown the testes of dissected plumed males they were much disturbed. This species is commonly used for dance ornamentation. The well-dressed Koiari wears a single skin on his forehead. It is attached to a circular head band so as to expose the iridescent green throat just above the performer's eyes. The tail and flank plumes protrude gracefully upward.

PERISHABLE COLORS (IMMATURE MALE): Bill Persian Blue, slightly more purplish around nostrils, becoming more bone colored at the tip. Inside of bill pale bluish gray washed with citrine yellow on inner half. Gape citrine yellow. Tongue pale vinaceous gray, becoming more citrine on inner half. Legs near Liver Brown. Iris near Apricot Yellow.

PERISHABLE COLORS (ADULT FEMALE): Similar to the former but with legs Pale Vinaceous Drab. Iris near Light Brownish Drab.

Paradisaea rudolphi rudolphi (Finsch)

Horseshoe Mountain (= Mt. Maguli): One male, two females, 4200 to 4500 feet.

Common above 4000 feet on Mt. Maguli, the only subtropical area that I had occasion to examine. Females were numerous in the middle tier of open ridge forest where they were usually found perching 20 to 40 feet above little forest openings. Although the females were scattered throughout the forest ridges they were invariably solitary, and usually from 50 to 200 or more yards distant from one another. When approached they uttered a penetrating rasping croak. On March 4, I observed a male in full plumage 70 feet up in a tree growing from the north flank of Mt. Maguli ridge. It was solitary and silent and appeared to be feeding in the topmost branches of a thickly decorated limb.

PERISHABLE COLORS (MALE): Skin around eye Plumbeous Black. Bill Gray (Gull Gray) washed lightly on sides of outer third and heavily on basal quarter with Chaetura Drab. Bill tip Gray; cutting edges of bill Slate Gray. Gape Dark Quaker Drab. Interior of mouth, gape, and basal thirds of maxilla and mandible Bright Deep Chrysolite Green; tongue and basal half of mandible groove Pale Violet Blue; tip of tongue Prussian Blue; anterior halves of maxilla and mandible Pallid Violet Blue. Legs Dull Violet Black with profuse Light Mouse Gray scutal margins; sides of legs almost completely Pale Mouse Gray with a faint vinaceous wash. Talons Dark Quaker Drab. Pads at friction points Ecu-Olive, elsewhere Mineral Gray. Nostrils blackish. Edge of gonydeal angle more blackish than Chaetura Drab. Iris pale gray? (Iris of adult female Light Seal Brown).

Amblyornis subalaris Sharpe

Horseshoe Mountain (= Mt. Maguli): One male, 3500 feet. Collected by a native on the Kokoda Track about Ioribaiwa.

Chlamydera cerviniventris Gould

Rouna: Four males, two females; Koitaki: one female; Tupusiele: one male, one female.

Common between the coast and 2800 feet in grasslands and forest edge containing bushes and spaced-out trees. Very common in the Rouna and Koitaki regions. When disturbed on the ground this bird flies to a small bush and then to the forest edge where it perches 30 or more feet up on an exposed limb. Several bowers are known to be located on the top of Hombron

escarpment. Because of a misunderstanding my Koiari natives failed to inform me of their location until I had returned to Port Moresby.

PERISHABLE COLORS: Bill black. Legs greenish gray; nails black.

***Ailuroedus crassirostris melanocephalus* Ramsay**

Horseshoe Mountain (= Mt. Maguli): One male, 3500 feet.

Collected by a native on the Kokoda Track above Ioribaiwa.

****Climacteris placens meridionalis* Hartert**

Very uncommon. The only example that I found was observed feeding on the Mt. Maguli ridge trail at an altitude of 4400 feet where it hunted on the butts of two trees 1 to 4 feet from the ground. This bird was in company with one example of *Rhipidura albolimbata auricularis* which I collected immediately after losing sight of the creeper. The flycatcher was taken from a perch 12 feet up in open ridge forest.

***Cinnyris jugularis valia* (Mathews)**

Koitaki: One male.

Fairly common in partially cleared areas near human habitations.

***Melithreptus lunatus albogularis* Gould**

Rouna: One male.

***Melidectes torquatus emilii* Meyer**

Horseshoe Mountain (= Mt. Maguli): Two males, three females, 4200 to 4300 feet.

Common in the open forest crown. Usually in flocks of three to six or more. Observed several times in company with *Pachycephala soror bartoni*.

PERISHABLE COLORS: Bill Pale Windsor Blue, becoming Water Green on gape. Gape wattle vinaceous. Eye ring Lemon Chrome; large naked area behind eye and partially around eye ring Orange Chrome. Wattles at side of throat Naphthaline Yellow. Legs Clear Payne's Gray; talons black; contact pads buff. Iris a little darker than Bay.

***Xanthotis chrysotis giulianettii* Mayr**

Lower Brown River: One male.

***Meliphaga aruensis aruensis* (Sharpe)**

Hombron escarpment: One male.

***Meliphaga gracilis cinereifrons* Rand**

Rouna: One male; lower Brown River Valley: one (?).

***Ptiloprora plumbea plumbea* (Salvadori)**

Horseshoe Mountain (= Mt. Maguli). Two males, 4200 feet.

***Pycnopygius cinereus marmoratus* (Sharpe)**

Horseshoe Mountain (= Mt. Maguli): Three males, 4200 feet.

***Philemon novaeguineae novaeguineae* (Müller)**

Rouna: Four males, two females, one female (?); lower Brown River: one male.

Abundant in grassland trees, about human habitations, orchards, and fairly common in the open forest. Found between sea level and 2800 feet. Always in small flocks. Most frequently encountered in the middle tier and canopy of eucalyptus trees bordering the Rouna road but apparently abundant in the most congested parts of the town of Port Moresby. The penetrating, oft-repeated bugle call of this species is without doubt the most distinctive avian sound to be heard in southern Papua. Local name: "Leather-head."

PERISHABLE COLORS: Bill, skin around eye, casque, legs, and nails slate black. Iris near Rood's Brown.

***Zosterops novaeguineae crissalis* Sharpe**

Horseshoe Mountain (= Mt. Maguli): Two females, 4200 to 4400 feet.

****Zosterops minor delicatula* Sharpe**

One specimen observed 12 feet up in a papaya grove within 30 feet of a group of houses at Koitaki plantation, 2600 feet, February 17.

Lonchura caniceps caniceps (Salvadori)

Vicinity of Jackson Airfield: One male, one female, one male immature, one female immature.

Abundant. Always in tightly knit flocks of up to 50 birds in lowland grasslands containing bushes and patches of swamp. Not observed above 400 feet.

Lonchura castaneothorax nigriceps (Ramsay)

Below Rouna: One male, 300 feet; near Jackson Airfield: one (?); 7 miles east of Port Moresby: one male.

AMERICAN MUSEUM NOVITATES

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THE DAVID ROCKEFELLER MEXICAN EXPEDITION OF THE AMERICAN MUSEUM OF NATURAL HISTORY INTRODUCTORY ACCOUNT

By HERMAN T. SPIETH¹

INTRODUCTION²

During the summer of 1947, the Department of Insects and Spiders of the American Museum of Natural History sent a five-man collecting team into the central plateau area of Mexico for a period of 13 weeks. This project was known as the David Rockefeller Mexican Expedition of the American Museum of Natural History, in honor of Dr. David Rockefeller whose generous aid made the trip possible. It had as its aim a general entomological and arachnological reconnaissance of the high plateau area.

The personnel of the group consisted of Dr. Mont A. Cazier, Dr. Charles D. Michener,³ Dr. Willis J. Gertsch, Mr. Rudolph Schramel, and the author. In addition, Mr. and Mrs. George Bradt of Santa Barbara, Chihuahua, were members of the group from June 16 until August 10 (fig. 1). For transportation a Chevrolet "carry-all" truck and two Willys "jeeps"⁴ were used. Each "jeep" drew a two-wheeled Bantam trailer upon which special plywood box-type bodies had been constructed. The Bradts had their own "jeep." It was thus possible to take all necessary

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² I wish to thank the several members of the expedition for their generous aid in the preparation of this paper, and especially Dr. Mont A. Cazier whose help and cooperation have been invaluable.

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⁴ Furnished through the kindness and generosity of Mr. Herbert F. Schwarz.

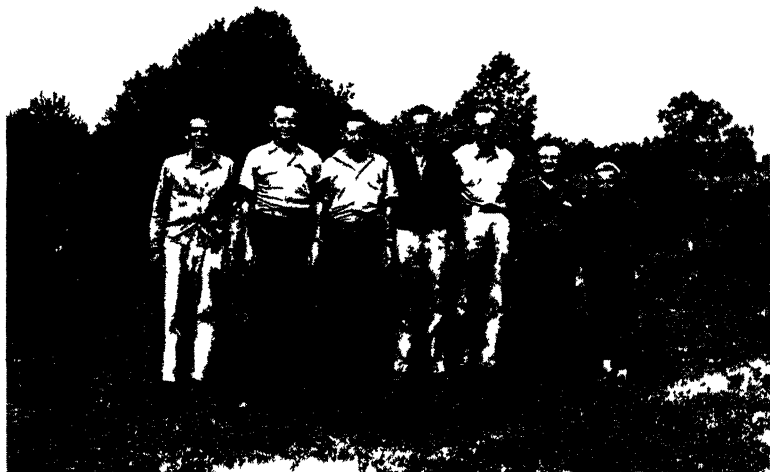


FIG. 1. Photograph of expedition personnel taken at Palos Colorados, Durango. Left to right: Bradt, Schramel, Cazier, Michener, Spieth, Gertsch, Mrs. Bradt. Photograph by George M. Bradt.

equipment for collecting, preserving, and properly storing insects, arachnids, plant samples, and other biological specimens; personal gear; canned, dried, and dehydrated food supplies; camping equipment; cameras and photographic supplies; plus five-gallon containers for extra gasoline and water. A fifty-gallon drum was stored in one of the "jeeps" to serve as a basic water reservoir. The physical equipment enabled the expedition to live as a self-contained unit and to penetrate relatively inaccessible areas. Furthermore the group was able to keep at a minimum the time and energy spent in actual moving from place to place and in the duties of housekeeping, such as pitching camp, cooking, etc. Most important, all specimens collected were easily and safely stored and transported without loss or damage.

GEOLOGICAL AND FAUNISTIC HISTORY OF THE MEXICAN PLATEAU

The reasons for selecting the Mexican plateau area for a major entomological expedition are numerous, the understanding of

which demands a brief review of the geological and faunistic history of the region.

One of the outstanding physiographic features of Mexico is the great, roughly wedge-shaped central plateau that extends southward from the Mexican-United States border. Physiographically and faunistically this region is a southward extension of the Arizona-New Mexico-west Texas section. Consisting of a high, bolson-studded region, it ranges in elevation from 3600 feet in the north along the border to 8600 feet south of Mexico City. On the east it is bounded by the Sierra Madre Oriental which are composed of highly flexed overthrusts of Cretaceous limestone; on the west, by the much higher and more rugged Sierra Madre Occidental which in places reach to over 10,000 feet. These latter mountains were produced by massive block faulting, volcanic extrusions, and subsequent severe erosion which resulted in the almost complete removal of the Cretaceous limestone strata which formerly overlay the region.

The broad intermontane area between the mountains, at least in the region north of a line drawn between Zacatecas on the west and Saltillo on the east, can be roughly divided into an eastern and a western region. The line of demarcation between these two areas has been called the Geomorphological Line by Leseur (1945). In the eastern area monoclinical faults, laccolithic intrusions, and volcanic eruptions have resulted in various Cretaceous limestone-capped topographical features. The intermontane basins of the area seem primarily the result of wind erosion, both constructive and destructive.

West of the Geomorphological Line and east of the Sierra Madre Occidental proper are a number of long connected ranges conforming with the typical northwest-southeast orientation that is characteristic of the mountains of the entire plateau. Between the ranges lie broad and extensive valleys, which are considerably higher than the basins east of the Geomorphological Line and are filled with adobe and gravel eroded from the surrounding mountains, plus scattered but vast amounts of intruded igneous materials.

The plateau area was elevated first at the beginning of the Tertiary. Following this there was an uninterrupted period of erosion lasting until the epeirogenetic activity of the Pliocene which, with the subsequent erosion and volcanic extrusions, gave rise to the present topography.

During the greater part of the Tertiary (Mayr, 1946) all of North America, including the Mexican plateau, was separated from South America. The isthmus between Colombia and the southern end of the plateau was broken into a number of islands so that various portals existed between the Pacific and Atlantic seas. These portals were of different durations, but probably the combined effect was such that a complete land connection between North and South America never existed from the Lower Eocene (50,000,000 to 60,000,000 years ago) and the Upper Pliocene (2,000,000 to 3,000,000 years ago). These gaps were of sufficient width to prevent almost completely an interchange of the mammalian fauna between the two continents (Simpson, 1940). Birds, as shown by Mayr (1946), were less hindered by the portals. Insects, being flying and passively air-borne creatures, also were probably less affected by water barriers.

During the Tertiary, while these water barriers were in existence, the climatic conditions of the Mexican plateau, plus all the rest of the southern half of North America, were subtropical to tropical. This has been emphasized by numerous investigators of mammals, birds, reptiles, fish, and plants (see Mayr, 1946; Chaney, 1947). Apparently the North American fauna and flora existing during this period were distinct and homogenous, not only for the Tropical and Subtropical, but also for the Northern Temperate, zones.

During the Pliocene two major events occurred that greatly changed the Tertiary faunal composition of western North America, i.e., (1) the large-scale mountain building of the post Middle Pliocene was accompanied by a trend towards lowered yearly rainfall, increased extremes as well as ranges of temperature, and a shifted seasonal distribution of the rainfall; (2) the water gaps between North and South America were closed.

The changed climatic conditions unquestionably eliminated many of the Subtropical and Tropical species in the western United States and allowed many of the species from more northern temperate regions to invade the more southern areas. At the same time the land bridge between North and South America enabled South American species to invade northward, particularly in the post-Pleistocene. Finally, as Axelrod (1948) has shown, the general climatic change in the western United States that followed mid-Pliocene time "essentially involved the disappearance of effective summer showers and the lowering of winter temperature."

In the Mexican plateau, however, effective summer showers are still a constant and regular feature of the climate.

Thus, entomologically, the Mexican plateau is of great interest since (1) either on it or upon its flanks should be found regions of interdigitation between the Neotropical species that have migrated northwards and the truly autochthonous forms that have survived and evolved during the period of climatic changes of the mid-Pliocene to the present; (2) if descendants of those Tertiary species that were eliminated in most parts of the western United States by the post mid-Pliocene climatic changes are to be found anywhere, they should be expected in exactly this area which probably now corresponds more nearly to lower Pliocene conditions than does any other part of North America. While evidence from plants, birds, mammals, and reptiles seems to confirm these ideas, the region has been practically unknown entomologically except for a few groups of insects.

It was from these points of view that the expedition was planned and executed. Cazier, leader of the group, Michener, and Gertsch all had had extensive collecting experience in the southwestern and western United States, and they had sufficient accumulated data and collections available from this area in their own particular fields of interest to enable them readily and accurately to evaluate the material collected in Mexico. The author was particularly interested in sampling the ephemerid and drosophilid fauna. He also wished to secure samples of *Drosophila pseudoobscura*, so that Dr. Theodosius Dobzhansky (1948) might be able to investigate the salivary chromosomes of specimens from this area, since it represented the largest geographical region from which the chromosomal races of this species were unknown.

RECORD OF THE EXPEDITION

On June 16 at 6 A.M. the expedition departed from New York City. The route selected took us through northern Georgia, and during the early afternoon of June 18 we reached Griffin, Georgia, and Lespedeza Farm, the estate of Mr. and Mrs. Frank Johnson with whom we spent the remainder of the afternoon and the night. By the evening of the twenty-first we had reached Sierra Blanca in the elevated, semi-arid country of western Texas. Previous to this we had collected casually in the evenings before retiring, but now systematic collections were undertaken. During this evening we used the electric head lamps that were found so useful through-

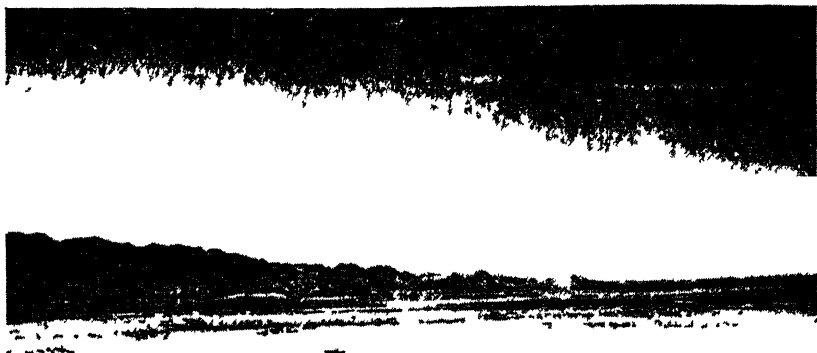


FIG. 2. View westward from dunes at Samalayuca, showing Desert Plains between mountains and dunes. Samalayuca lies in middle background.

out the trip for collecting arachnids and Coleoptera at night, and Cazier caught the first specimens of the cerambycid genus *Mon-eilema* which feeds on cacti.

El Paso, Texas, was reached early Sunday morning, June 22. Gertsch, who had been in Utah, joined the group at this point. A goodly number of hours were spent collecting in the vicinity north and west of the town where a large general collection was made, including an interesting wolf spider and more specimens of *Moneilema*. Michener (1948) also made some novel observations on the mating behavior of the harvester ant, *Pogonomyrmex barbatus* (Smith).

On June 24 the expedition crossed into Mexico at Ciudad Juarez, Chihuahua, and proceeded southward on the main road to Chihuahua city, which is marked in kilometers showing the distance from Juarez. The entire road from Juarez to Chihuahua city is a well-constructed, well-graded, asphalt highway. After leaving the valley of the Rio Grande, we entered a region of Desert Plain. These plains have two outstanding plant formations, i.e., Desert Grasslands and Desert Shrub. The grassland dominant is *Bouteloua eriopoda*, the black grama, and the shrub dominant is *Larrea tridentata*, the creosote bush. These two com-



FIG. 3. Dunes near Samalayuca

munities grade into each other almost imperceptibly. Shantz (*in* Shantz and Raphael, 1924) says: "The line of demarcation between the southern desert shrub and the desert grassland is difficult to draw. Over great stretches of grassland are scattered shrubs and other large southern desert plants." He places areas dominated by shrubs in the Desert Shrub community, "while areas which show only scattered shrubs over the grass cover have been mapped as Desert Grassland." Leseur (1945) feels that in northern Chihuahua much of the Desert Shrub represents climax vegetation, but that when the Desert Grasslands are overgrazed then the Desert Shrub invades as a subclimax. While much of the entire trip was spent in more mesic areas, repeatedly we shuttled back and forth between these two communities of the Desert Plains.

South of Juarez at kilometer 53 is Samalayuca (elevation 4360 feet), a village that is in the center of the bolson region. East of the town are vast expanses of high sand dunes which are 94 per cent silica (Leseur, 1945) and reach a height of at least 190 feet (figs. 2, 3). Farther east of the dunes lie the Sierra del Presidio over which the sand that forms the dunes is blown by the prevailing east winds. The dunes are virtually bare of vegetation, but scattered about the region are smaller stabilized dunes which have a sparse vegetation. We entered this area just before the start of

the summer rains, and the extremely dry, bare surface sand was easily moved by the winds. Leseur (1945) reports that during the rainy season the dunes settle and become green with seedlings. Within a short time the entire region then supports a luxuriant growth of annuals. Other than the dunes, the land around Samalayuca has been heavily overgrazed and is now invaded by the creosote bush, acacias, mesquites, and other shrubs (fig. 4).



FIG 4 Badly overgrazed area near Samalayuca

Just on the eastern edge of Samalayuca we camped in a cleared space about 100 yards east of the house of Señor Pedro Moreno, taking advantage of a small, stabilized dune and some mesquite bushes. For four days we collected intensively in the area north, south, and east of the town. The resultant collections clearly show that the insect fauna of the area is predominantly made up of Sonoran zone species. During the day specimens were collected by the standard methods of beating, netting, and digging. After darkness had settled, collections were made with the aid of two types of lights: (1) Gasoline lanterns were set in the centers of 6- by 6-foot sheets of white canvas that were spread upon the ground. The organisms were attracted to the lights and upon landing on the sheets were picked up and placed in cyanide jars. Five lanterns and sheets were used throughout the entire trip in

this manner with excellent results. (2) Each member of the expedition was equipped with an electric head lamp. With the aid of these we were able to locate nocturnal specimens both on the ground and on the vegetation. The latter method was especially useful for collecting Coleoptera and Arachnida and was most rewarding between the hours from 9 P.M. to midnight. Michener was particularly desirous of collecting the bee fauna, creatures which are most active during the hours immediately after sunrise.

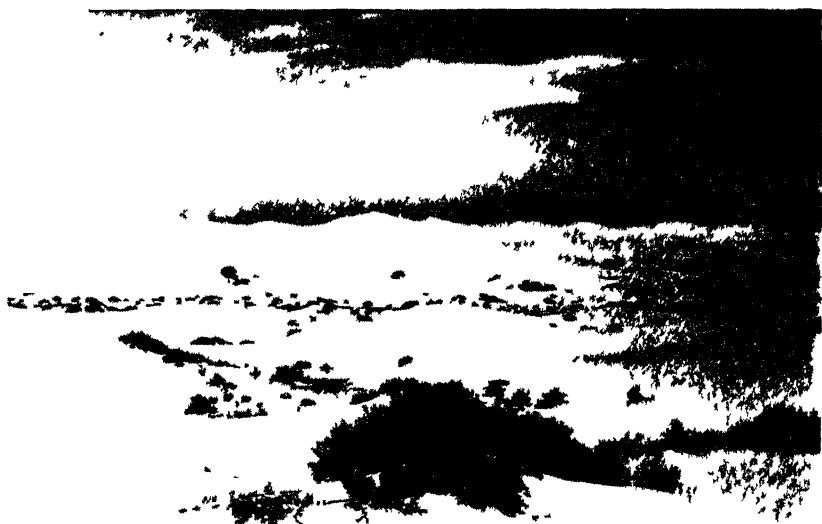


FIG 5 Dunes near Samalayuca, showing vegetation growing in depressions

On June 26 Gertsch and I hired horses from Señor Moreno and, with his son Ruden as a guide, we rode over to the dunes east of the ranch. The northern end of this great dune area is east of Samalayuca. The mass is at least 2 miles wide and possibly 30 miles long, stretching southward and approximately parallel to the main Juarez-Chihuahua highway. At the northern end just within the dunes a few cottonwood trees were growing; in one of the blow-outs there was an open spring which had been boxed in with lumber and was the source of water for a small herd of cattle that ranged through the vicinity. Ruden showed us how, by digging in some of the blowouts, it was possible to reach water within 18 inches of the surface of the sand. Upon climbing to the highest dunes we could ascertain with field glasses that no vegetation was growing on the summits of the dunes (fig. 5), although squaw bush,

a composite known locally as "jara," and some other plants were growing in the depressions.

The end of June, just before the summer rains start, is the hottest season of the year for this vicinity, and the four days we spent there were very hot, especially during the hours from two to four o'clock each afternoon. The nights, particularly after midnight, were cool. Because of the high daytime temperatures, we erected only one tent which served as a place to store duffle. In addition we set up a flat canvas with poles at each corner to create shade and still allow the air to blow freely through, thus avoiding the



FIG. 6 Terrain between Samalayuca and Villa Ahumada, showing low, much eroded mountains in background

hothouse effect of the tent. Under this canvas each afternoon between 2 P.M. and 4 P.M. the temperature reached 46°C . (126°F .), but by 6 P.M. it fell to 38.5°C . (101.5°F .).

We left Samalayuca on the morning of June 27. After passing through some partially stabilized dunes just south of the town, the road runs through Desert Plains until at kilometer 74 another *Bouteloua gracilis* mesa occurs. Leseur (1945) believes that the *B. gracilis* mesas south and north of Samalayuca are due to the watering of these areas by run-off from the surrounding hills. From time to time we stopped to collect. At one place we found an

open spring beside the road and collected a large series of tiger beetles representing four species, all Sonoran in relationship. A great deal of erosion has taken place throughout the region and the hills stand up as low, isolated sentinels, with broad, gently sloping plains all about their feet (fig. 6).

In the early afternoon we reached the town of Villa Ahumada (elevation 3874 feet). Near by is Laguna de los Patos which on occasion, Leseur (1945) reports, may partially fill with water. The town depends for water upon seven artesian wells, the water from which is used for extensive irrigation. Leseur (1945) reports the yearly average precipitation as 19.1 cm. which is 3 to 6 cm. lower than that reported from Chihuahua city or Texas stations of similar altitude. Of this precipitation, 60 per cent occurs during the July-August-September period. During the winter the lowest average temperature of -13.4° C. occurs during January. At Villa Ahumada the days are hot and the nights cold as a rule. Sunshine occurs 80 per cent of the possible time. Evaporation is always high. Surprisingly enough, frost-free days occur only from about May 1 until October 1. Since the summer rainy season does not begin until the end of June, the growing season is only about 100 days, or 50 shorter than the frost-free period. With minor variations, the climatic picture probably is typical of the large Desert Plains area that occupies northern Chihuahua.

South of Villa Ahumada the elevation of the land becomes somewhat higher and the vegetation becomes more typical Desert Grassland with *Bouteloua* grasses and scattered mesquite bushes. The road swings westward and then southward again at kilometer 257, now paralleling a long range of mountains west of the road. At Parrita, 92 kilometers north of Chihuahua city, a road leads westward into Cañon de Santa Clara. East of the road lies Ojo Laguna, which is a region of dense mesquite at the edge of a dry lake.

Here we left the main highway and turned westward into Cañon de Santa Clara. Across the plain between the main road and the mountains the dirt road was comparatively good. When we entered the mountains, we found the road unimproved and often following the stream bed, even though it is one of the major east-west transportational arteries from the high llanos to the west. Down the road came a sparse but steady flow of trucks bearing produce from the ranches of the llanos, lumber from the sawmills of the higher elevations, and loads of wood suitable for fuel for the

people of Chihuahua. The combined effects of all these kept the road in a rough but passable condition. At first the valley was very narrow, but soon it broadened. The stream flowing through the valley is an intermittent one and at this time of year it was dry. At the mouth of the canyon the stream has poured onto the Desert Plain a large alluvial fan. The dry lake east of the Juarez-Chihuahua road in more mesic times must have been fed by the flow from Cañon de Santa Clara.



FIG 7 Broad valley of Cañon de Santa Clara showing road at left and also effects of overgrazing

We located a suitable camp ground 5 miles west of Parrita at an elevation of approximately 5500 feet.¹ At its mouth, Cañon de Santa Clara is narrow, but above the place where we camped it widens out into a broad flat floor through which the stream follows a sinuous course. Here and there side canyons branch off, but only

¹ For the sake of determining elevation we carried an altimeter, which was kept set at 29.92 inches regardless of atmospheric conditions. All elevations that are indicated as "approximate" are derived from our altimeter readings. Other elevations were acquired from published works or from information from local residents.

one, Cañon Prieto, is large. At the junction of Cañon Prieto with the main canyon there is a small settlement known as Primavera. In addition to Primavera other habitations are scattered throughout the canyon. East of Primavera the main canyon becomes progressively narrower and the gradient increasingly steep until the height of land is reached at approximately 7200 feet. In much of the upper part of the canyon the road is so narrow that it is of one-car width only. The mileage as indicated on our cars from Parrita on the Juarez-Chihuahua highway to the 7200-foot crest is approximately 20 miles.



FIG. 8. Cañon de Santa Clara with gently sloping sides and *Quercus santaclarensis* consociation.

The valley floor of the canyon is boulder strewn and in the broader parts filled with a coarse alluvium. On this floor grows a scattering of oaks, willows, junipers, platyopuntias, yuccas, and grasses. In the wider sections of the canyon (figs. 7, 8) the sides of the valley are not exceedingly steep and the vegetation is similar to that of the valley floor. The upper slopes and the tops of the mountains are covered with oaks, appearing to be a typical

Quercus santaclarensis consociation as described by Leseur (1945). On the rocky cliffs and the steep rocky hillsides ocotillo and various cacti grow in considerable numbers. The rocks themselves are brightly colored, mostly a rich deep red, and numerous brightly colored lichens grow on the exposed cliffs. The entire valley, especially the floor and lower hillsides, has been heavily overgrazed by burros, horses, sheep, goats, and cattle. While the oaks of the area are not suitable for lumber, they do furnish wood for fuel. In the upper parts of the canyon and particularly in Cañon Prieto wood collectors were active, hauling fuel wood out of the hills by means of burros.



FIG 9 Cañon Prieto, showing general terrain and large pines

Cañon Prieto is much narrower than Cañon de Santa Clara proper. The road, leading upward, crosses and recrosses a small stream in which at the end of June, 1947, were numerous pools of water. At approximately 6500 feet there are many large pines (fig. 9). From there on up the canyon the vegetation is of a mesic nature. At the head of Cañon Prieto there was an active sawmill. On the slopes and valley floor are pines of more than 3 feet in di-

ameter. In addition to *Pinus ponderosa*, another equally large species of *Pinus* and also numerous junipers of similar size are present. At this point the canyon walls are very steep. I climbed to a height of land and entered a level Oak Savanna. Mixed with the oaks were a few pines and junipers. In the surrounding areas, however, the north-facing slopes were clothed primarily by pines, while the southern exposures had a mixture of pines and oaks.

We spent June 27 to July 1 in the region of Cañon de Santa Clara, making collections on the Desert Plain both north and south of Parrita and at Ojo Laguna, in Cañon de Santa Clara between 5500 and 6000 feet, and in Cañon Prieto between 6500 and 6800 feet. Collections thus were made in four distinct plant communities, that is, the Desert Grasslands, the Desert Shrub, the *Quercus santaclarensis* consociation, and the Montane Forest. Around Ojo Laguna the fauna was definitely Sonoran zone in character, the species collected being those that are common to the desert areas of the southwestern United States. At our camp in Cañon de Santa Clara were found representatives of the transitional zone elements common to the lower portions of the mountains of Arizona, e.g., the lycid and longhorn beetles, while the Montane Forest area yielded species that are also found in the high mountain regions of Arizona.

The summer rains were just commencing during the period we spent in the region. At our camp at 5500 feet at about nine o'clock each morning, the wind started to blow from the east up the canyon. By midafternoon huge cumulus clouds built up, and thundershowers occurred at the higher elevations. Several times we had light showers late in the afternoon at camp. By sundown or shortly afterwards the clouds dissipated and, some time later, the wind reversed and blew down canyon. By early morning the wind died down and thus each morning was clear, bright, and calm. During the day the temperature at camp rose to 35° C., but the nights were cool. Out on the plains at the mouth of the canyon, the clouds rarely accumulated and the daily maxima of temperatures were much higher.

On the morning of July 2 we broke camp and trekked westward up the canyon. At the crest we entered a park-like area with oaks, pines, platyopuntias, and grasses as the dominant plants. From here the land slopes gently westward into the valley of the Rio de Santa Clara. As we dropped gradually to lower elevations, the trees became sparse and gave way to the grasslands known as

llanos that fill the center of the valley. Here and there tongues of oak woods extended for a short distance out into the grasslands. These grasslands fill the north-south oriented valleys that lie between the parallel mountain ranges flanking the eastern side of the Sierra Madre proper (see fig. 52). They represent the *Bouteloua gracilis* consociation of Leseur (1945).

Just as the road entered the grasslands it forked, and we chose the northern one. Arriving shortly at a Mennonite settlement, we were startled to see large amounts of mechanized, well-kept farm equipment. Great tracts of these grasslands are now being used for growing wheat and other grains. Although the land is fairly



FIG 10 Llano de Rio Santa Clara

level, the type of torrential rainfall that occurs here will cause, and even now is causing, destructive erosion in many parts of this magnificent grassland. Here and there protruding through the grassy covering are the remains of ancient volcanic activities: rotting cones and dikes, and large areas of decomposing lava flows. The road itself consists merely of wheel tracks across the llano (fig. 10). Whenever the ruts become too deep, a new route just beside the old is selected. The greatest danger in driving across this area is the series of "high centers" existing between the ruts and often striking the under parts of a car. We did not expect to find many insects in such a uniform and restricted habitat, but

we paused to collect and were all surprised to find that this virgin grassland was fairly teeming with insects.

In the center of the llano we came upon the Rio Santa Clara, at this season a small stream, which flows northward into Laguna de los Patos at Villa Ahumada. At the crossing the elevation was approximately 6000 feet. A few cottonwoods and willows grew along the stream in some places, but mostly the banks were treeless. Aquatic insects were abundant, but I was struck by the lack of ephemerid nymphs. In many ways the stream's aspects reminded me of the small rivers of the central United States during midsummer conditions.

West of the Rio Santa Clara we found very extensive cultivated tracts, and many large stacks of straw resulting from the threshing of wheat dotted the landscape. Leaving the llano, we again entered an Oak Savanna. The crest of the ridge was approximately 7100 feet and the distance by car from this crest to the crest of Cañon de Santa Clara was 37 miles. The llano proper I estimated to be 20 miles in width at this point. Crossing the pass, we again sloped downward into another llano. Lying closer to the Sierra Madre, it seemed more mesic than the preceding llano. The valley is drained by the Rio Santa Maria which flows northward into Laguna Santa Maria. Along the banks of the river lies the sprawling town of Namiquipa at an altitude of 5996 feet. The maximum temperature recorded for the town is 39.8°C ., the minimum -18.8°C ., and the average annual rainfall is 17.2 inches, of which 11.3 inches fall during July, August, and September (Arias, 1942). Grazing, cultivation, irrigation, some mining, and the general effect of long-time human habitation have modified this llano greatly.

We pushed on to the woodland area at the western edge of the llano and camped for the night at an approximate elevation of 6600 feet. We were obviously at the foot of the long steep grade that would take us to the top of the next cordillera which was the continental divide. Early the next morning we broke camp and headed up the 4-mile-long grade that carried us to the top of the mountain. The continental divide is at 7700 feet at this point and is a beautiful, park-like area of the Montane Forest community (fig. 11). Here we collected for several hours, Cazier getting several subspecies of tiger beetles which are related to subspecies that are common in the southwestern United States not only at high, but also at low, elevations. Then we started downward into



FIG. 11. Continental divide east of San José Babícora, showing park-like pine area.

the next llano. Although we had passed the divide, the Sierra Madre Occidental were still to the west of us, and it was necessary to cross another llano before we reached them. In this llano and extending into the mountains was the vast Babícora Ranch.

At an elevation of approximately 7500 feet we reached a pond formed by the damming of a small stream and known locally as a "tank." At the tank there was a small meadow with a brilliantly green sod; the oak trees were sparse, the pines still rarer. The area obviously had received more rain recently than the regions to the east, and the grasses were pale green from fresh growth. Here again we stopped to collect, and Cazier gathered a large series of the brilliant blue scarabid *Phanaeus quadridens* and also *Cicindela obsoleta santaclarae*.

We spent several days at Babícora Ranch, one of the high spots of the trip. Our genial host and hostess, Señor and Señora Frank Fry, know the country well and gave us much valuable information as to the history, the biota, and the geography of the region. The ranch headquarters, known as San José Babícora to dis-

tinguish it from a subheadquarters known as Santa Anna Babícora and also from another, more northern, completely unrelated Babícora, consisted of the ranch house, offices, stables, assorted buildings, and domiciles for the employees and their families. The ranch headquarters lie at an elevation of 7150 feet just within the edge of the llano. Westward a short distance lies a timbered area of mixed oaks, pines, and madrono (fig 12). On the ranch were 17



FIG 12. Forest area near San José Babícora.

active sawmills, one of which was close to the ranch headquarters. Many of the larger pines in the near-by forest had been recently felled. The tops that were still lying on the ground made an excellent collecting spot for large cerambycids, which were attracted to the fallen trees as ovipositional sites. On the night of July 4, Michener and Gertsch returned to the tank for night collecting, while Cazier, Schramel, and I investigated the treetops. Both parties had marvelous collecting, Michener and Gertsch getting hundreds of specimens, including a rare species of a silk moth and new species of crab spiders. We got numerous cerambycids and also, on the way back to the ranch house, we found on the large junipers growing in the grasslands many specimens of the ubiquitous scarabid genus *Diplotaxis*. Interestingly enough the cerambycids collected in the fallen trees were conspecific with

those found at higher elevations in the pine forests of southern Arizona.

In addition to the excellent night catches, the daytime collecting was good. Here at Babícora we were able to sample again three distinct plant communities, that is, the lower edge of the Montane Forest, the *Quercus santaclarensis* consociation, and the *Bouteloua gracilis* consociation. In comparison to the Cañon de Santa Clara collections, the *B. gracilis* community had now replaced the Desert Grasslands. Further, it should be noted that all three communities were closer together in this area than were the three at Cañon de Santa Clara.

On July 5 we left Babícora, driving westward and northward across the llano until we reached the railroad at a point just south of Estación Babícora which serves as the shipping point for the ranch. On this llano we collected a huge series of the meloid, *Pyrota postica*, which occurs also in Texas and New Mexico. Running from Juarez to Chihuahua city are two railroads. The first and shorter one follows the Desert Plains, while the second is much farther west and runs along the foot of the Sierra Madre Occidental, serving the needs of the lumber, livestock, and mining industries of the high llanos and mountains. Now the road turned left and roughly followed the railroad. It was our plan to collect in and along the edge of the great Sierra Madre. South and west of Babícora lies the highest and longest mass of the Sierra Madre, of which Mt. Mohenira is almost 12,000 feet high (Moore, 1945). The rainy season had started in earnest, and all afternoon we encountered showers. Camp was pitched at approximately 7200 feet in a small pine grove overlooking Madera, a town which lies in a llano at an elevation of 6800 feet. Collecting, except for *Drosophila*, was poor in general that evening, perhaps due to the low temperatures and the light rain.

Sunday, July 6, we drove through Madera, Yeponera, Temo-sachic (elevation 6095 feet), and Matachic. We were now in the Pacific drainage, the streams being tributaries of the Rio Arosa-Papigochic. The road led across small llanos, through the Oak Savannas, across streams beside irrigated land. The llano at Madera was given over mostly to cultivation, but llanos around the other towns seemed mainly used for grazing. Active and excessive erosion was obvious in many places. At Matachic a side road crosses the Rio Arosa-Papigochic and heads southwest towards the mining town of Ocampo in the high tumbled Sierras. We took

this road, forded the shallow river, which was about 100 feet wide, and passed through the grassland and juniper zone into the Oak Savanna. The road rose slowly, and about 2 miles from Matachic we found a good camp site. Around the camp were oaks, pines, junipers, and a few platyopuntias. The road to Ocampo rose sharply beyond our camp site and crossed a pass at 7200 feet. At this point it skirted along a peak that is probably over 8000 feet, but only on the north face were there pines of large size. Beyond the pass the road entered a huge, undulating valley whose floor is at about 6000 feet. This entire valley is covered with an Oak Savanna except for a small agricultural portion along the stream that drains the area. Some of the oaks were of the dry-season deciduous type and were just now, at the start of the wet season, leafing out.

Arriving in the late afternoon of July 6, we stayed here until the morning of July 9. During that time collections were made in the vicinity of the town of Matachic, along the Rio Arosa-Papigochic, in the oak-pine-juniper area around camp, and in the great Oak Savannas to the southwest. Gertsch and Cazier caught three specimens of the scarab genus *Plusiotis*, a number of species of rare cerambycids, and Gertsch also had excellent results by sifting detritus under the oaks for arachnids. I caught the first adult specimens of ephemerids as well as numerous nymphs and sub-imagoes. Again I was impressed by the fact that the facies and fauna of the streams showed a great apparent similarity to those of streams in the midwestern United States during late summer. The adult ephemerids (*Isonychia intermedius*) showed a remarkable ability to resist desiccation and were found sitting on bare acacia twigs in the bright midday sunshine.

On July 9 we broke camp and started for Chihuahua city. The road into the Ocampo region was so bad that we decided not to try to investigate that area. We were constantly troubled in many parts of Mexico by the almost completely unmarked road system, the fact that often the main roads were not so good as the local ones, and also by the difficulty of getting accurate and reliable information from the local population. In this case we took the "good" road instead of a couple of wheel tracks that represented the desired route. We eventually reached Chihuahua city via Cañon de Santa Clara.

Chihuahua is a pleasant, clean city located at an elevation of 4667 feet, surrounded by Desert Grassland and Desert Shrub.

Much of the surrounding area has been badly overgrazed. After the cool highlands we found the temperatures oppressively hot.

On July 11 we drove southward on the Chihuahua-Camargo highway, a well-planned modern road similar to that north of Chihuahua city. Michener had found bee collecting in the higher elevations to be relatively poor, but about 10 miles south of the city he struck a rich collecting spot where the bees were feeding on the flowers of *Cevallia sinuata* Lagasca. At Meoqui the road crosses the Rio San Pedros. A few miles to the east the San Pedros joins the Rio Conchos, a still larger river, which flows northeast and empties into the Rio Grande at Ojinaga. The waters of both rivers are used extensively for irrigation purposes, and recently large and extensive additions have been made to the irrigation system. We turned off the main highway south of Las Delicias and went eastward until we reached the Rio Conchos. After encountering a wind squall and rain that literally tore the license plate from the "carry-all," we finally found a suitable camp site on the banks of the river. The altitude was slightly lower than 4000 feet, the temperatures were high during the day, and the nights were warm. Owing to the stream, the irrigation, and the mesic nature of the vegetation, the humidity was relatively high. Before being irrigated this entire area was Desert Shrub. Along the river itself willows and cottonwoods grew in great numbers. We stayed here for two nights and a day. Aquatic collecting was poor, but terrestrial collecting was good. We found blister beetles in considerable numbers. While crossing the llano at Babicora we had collected great numbers of meloids, but no one had suffered any blisters even though in our eagerness we had picked up the insects with our fingers. One species at Las Delicias was different, and Schramel and Gertsch unintentionally and Cazier deliberately (testing the vesicant potencies of the beetles) acquired nasty blisters.

Sunday, July 13, we departed for Camargo en route to Parral. At first the highway led through irrigated country, and at one place we discovered thousands of meloids of the species *Pyrota akhurstiana* flying across the road and settling on the surrounding vegetation. We collected an adequate sample. It should be noted that at least nine meloid species collected at and around Las Delicias are also common to Texas and New Mexico.

Leaving the irrigated area, we were again in the Desert Shrub. Paralleling the road was a huge irrigation canal and at various

points we found irrigated sections, some in the process of being developed. Just north of the city of Camargo the paved highway ended and after crossing the river, we approached the town during a driving rain storm. Although there are great variations in the total annual precipitation for this region (6.7 to 19.1 inches; Shreve, 1944) the average is about 10 to 11 inches, and certainly the town received a high percentage of that during this one storm. At first, owing to the heavy rain, the rough, poorly marked, desert road south of Camargo was slick and difficult, but gradually we reached drier terrain and easier traveling. About 25 miles southwest of Camargo we camped under some cottonwoods in a Desert Shrub area, dominated by mesquite, creosote bushes, and acacia (fig. 13). The elevation at the camp was approximately



FIG. 13. Gertsch collecting in Desert Shrub area between Camargo and Parral.

4500 feet. Although slightly higher than Las Delicias, the temperature was still high. The daytime collecting, especially for bees and beetles, was good at this arid desert location, with bees of the genus *Hemisia* being particularly abundant and conspicuous on some of the desert flowers. Night collecting with the lights added numerous specimens of saturniid moths and camel-backed crickets.

As we went farther southwest the elevation of the land rose gradually, almost imperceptibly. The country gave the impres-

sion of a vast level plain, but occasionally we passed through shallow depressions in which the waters of the recent rains had collected and softened the ground. Such spots were excellent collecting areas, especially for meloids of the genus *Megetra* and the beautiful *Cysteodemus wislizeni* (fig. 14). As the elevation



FIG. 14. Shallow depressed area on route between Camargo and Parral, showing heavy vegetation. Numerous meloids were congregated in such spots.

increased, patches of Desert Grassland began to appear here and there. Finally, after traversing a range of low hills, we came out upon the main Parral-Jeminez highway. Turning west we headed for Parral and finally made camp 15 miles east of the town. Here the slopes were dominated by creosote bushes, chollas, and platyopuntias, while mesquite grew at the bottoms of the slopes and a few oaks in the wetter places. We collected that night and the next morning before breaking camp.

Noon of the sixteenth found us in Parral, a city famous since the early days of the Spaniards as a mining center. West of Parral are two other mining centers, Santa Barbara and San Francisco del Oro. At the former place the American Smelting and Refining Company has a large mine. Mr. George Bradt and his wife were school teachers for the English-speaking colony, and we had made arrangements to visit with them. They are both interested in natural history and had explored the region thoroughly, taking

many pictures and collecting numerous specimens, especially reptiles, for the American Museum of Natural History. We arrived at Santa Barbara in midafternoon, going to the company's compound which, through Mr. Bradt's kindness and that of the company, served as our home and headquarters for the time we were in the region.

Santa Barbara lies near the Chihuahua-Durango border at an elevation of 6300 feet (fig. 15). It is almost surrounded by moun-



FIG. 15. View northwest from San Francisco Mesa, showing mountains between Santa Barbara and state of Durango border.

tains that are over 7500 feet high. Once these mountains were covered with trees, but these have almost all been cut, most of them many years ago. Now the mountain tops and slopes are covered with grasses, century plants, a few shrub junipers, and some cacti (fig. 16). The country between Santa Barbara and Parral is mostly grasslands, and much of it has been cultivated. Two days were spent collecting in the vicinity of Santa Barbara: in a narrow valley at a place known locally as Cobrisa, on the plains east of the town, and also on the San Francisco Mesa at an



FIG. 16. View from San Francisco Mesa looking in direction of Parral. The foreground was formerly covered with oaks.

elevation of 7500 feet. The latter locality yielded many beetles, especially cicindelids of northern origin and scarabids of southern affinities. In addition an interesting series of bees (*Xenoglossa* and allies) was garnered from the flowers of the squash vines which grew in the Bradts' vegetable garden inside the town of Santa Barbara.

On the nineteenth we set out in company with the Bradts for the high mountains west of Santa Barbara. We hoped to get at least into the Montane Forests in the region of Gauchochic and, if possible, into the barranca region on the western side of the Sierra Madre. Our route took us past San Francisco del Oro, westward along an abandoned railroad, then northward up into the mountains via a well-graded road. After driving 20 miles from Santa Barbara we reached a crest at approximately 7150 feet. The mountains were clothed principally with oaks, but, at the top of the pass, pines were found. An extremely steep descent brought us into a narrow valley (elevation approximately 6300 feet) in which is located a ranch called La Saucedá. At our lunch stop we made a small collection in a region of oak, juniper, and mesquite. Dropping downward we entered a still larger valley whose floor stands at an elevation of approximately 5900 feet. While rela-

tively narrow, it is about 25 miles long. The floor of the valley is llano-like, except that here and there Oak Savannas exist in the wetter parts. The grassland appears to be virgin, has not been seriously overgrazed, and woodcutters probably have not touched the oak woods. The area is known as La Noria from the name of the largest ranch in the valley. After leaving the llano we passed through some rolling hills and entered a rather heavily populated agricultural area around the town of Huejotitlan.

A short distance west of Huejotitlan a side road turned north towards the Vallé de Olivos where there was a ranch called Pelayo which we wished to visit. There were rumors that mastodon bones had been found in the silt of a stream at that place. We therefore turned north over an obviously poor road and, with the aid of a Mexican guide who had accompanied the Bradts, drove over the most badly eroded land that we saw on the entire trip. Over vast areas the soil was extremely thin, the underlying rock strata stood on edge, and the roughness of the terrain was conducive to heavy erosion. Ocotillo and cacti were abundant; in the low spots mesquite was found. At Pelayo (approximate elevation, 5400 feet) we found an arroyo cutting deeply through a thick bed of black silt that once must have been deposited on a lake bottom. Here and there layers of marl could be seen in the silt. The present stream has cut through at least 20 feet of these deposits. After paying our respects at the ranch we went out some distance and found a camp site. Collecting both that night and the following morning was good, although we found no mastodon remains.

After retracing our tracks of yesterday we arrived at the junction just out of Huejotitlan, turned westward, and after about 12 miles' driving reached the Rio Belleza. This stream was about 100 yards wide and had two fords at this point. In the dry season these are easily passable, but, now that the rains had started, they were obviously too deep to attempt crossing, and the chances were that the water might rise higher during the next few days. During the rainy season all motor traffic to regions west of the stream normally stops. Sadly we decided that we must cancel our planned trip and return to Santa Barbara. Along the river were cottonwoods with mesquite and cacti on the slopes of the bank. After making a good collection we returned to Huejotitlan and then pushed on into the rolling oak-covered hills that lie on the road towards the valley of La Noria. Here late in the afternoon we pitched camp.

On July 21 we returned to Santa Barbara. En route we stopped in the llano of La Noria (fig. 17) and here again, just as in the virgin grassland of Santa Clara, we collected an almost unbelievable number of insects in the short grass. On arriving at the top of the pass we stopped for lunch and afterwards collected a series of embiids—strange, semi-social insects that spin silken tunnels under rocks (fig. 18). In addition to the embiids, a fine collection

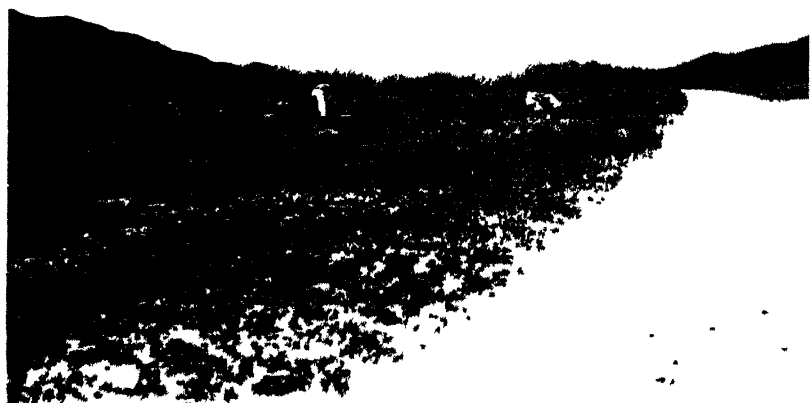


FIG. 17. Virgin grassland at La Noria with summer storm sweeping valley in background.

of other insects was taken, among which were the first tiger beetles of Neotropical origin. Gertsch also collected numerous specimens of large whip-scorpions, or vinegaroons, which from now on constituted a prominent element in the arachnid ground fauna (fig. 19).

Later in the day Schramel, riding in the front "jeep," spotted a handsome specimen of a black-tailed rattler. We easily cornered it, and Bradt took a fine photograph of the snake (fig. 20).

When we reached Santa Barbara I received the disheartening news that the living specimens of *Drosophila* that I had been mail-



FIG. 18. Top of pass at La Saucedá, showing habitat where embriids were collected.



FIG 19. Whip-scorpion or vinegaroon



FIG. 20 Black-tailed rattler taken near La Saucedá. Photograph by Mr George M Bradt.

ing to Columbia University were dead upon reaching their destination. Thus one of the objectives of my summer's work was being frustrated because the specimens were being exposed to excessive heat in transit. At Santa Barbara I had been very successful in collecting large series of the species, and I resolved to fly the

specimens to El Paso myself. Thanks to the kind aid of President Harry N. Wright of the City College of New York, I had funds to cover such emergencies. The air route from Mexico City to El Paso included Parral, and I was thus able to execute my plan. Reaching El Paso, I air-expressed the insects to New York and returned to Parral by plane the next day.

In the meantime the other members of the group had been collecting in the area south of Parral at Salices. Here in addition to normal collecting, a large cave was investigated, and a new spider



FIG. 21 *Dynastes granti*. Specimens and photograph taken by Mr. George Bradt at Santa Barbara, Chihuahua.

species of *Psilochorus* was taken, while at the mouth of the cave was found a large series of *Nesticus pallidus*, a species common in the caves of the southern United States. Outside the cave the cerambycid and buprestid fauna had affinity to the fauna of the southwestern United States (fig. 21).

By the time I reached Santa Barbara the expedition was packed and ready to leave for Durango. Again the Bradts were to accompany us. Swinging south we drove through grassland and farmland to the town of Las Cuevas, southeast of which we entered a

grassland area of great extent and beauty. Again the hills were covered with oak and the rocky places with ocotillos, acacias, and a few platypuntias (fig. 22). Somewhat off the road at a place called Catarinas we found a fine camp site beside a large tank, almost large enough to be called a lake. Here, at an approximate elevation of 5900 feet, under the willows and cottonwoods we pitched camp. The summer rains had been sufficient to change the grasslands into beautiful green meadows, and along the streams numerous flowers were in bloom. The lower lands beside



FIG. 22. Ocotillo and associated plants on rocky area at Catarinas camp.

the streams were under cultivation, but most of the area was devoted to pasture. July 25 and 26 were spent here collecting. On the twenty-sixth I climbed a small, cone-like mountain (fig. 23) and found the top carpeted with dead harvester ant males. Apparently their nuptial flight had occurred here, at the highest point in the surrounding country. At this camp Michener collected two large and beautiful green bees of the genus *Euglossa*, the northernmost record for bees of this group.

Sunday, the twenty-seventh, we moved southward through the grasslands, collecting as we went. At one point Cazier spotted the carcass of a cow that had reached just the proper stage of decomposition to attract certain scavenger beetles of the genus *Trox*.



FIG 23. View of region at Catarinas camp, showing grassland and small, cone-shaped mountain upon which innumerable dead *Pogomyrmex* males were found

After crossing a low divide we dropped into another valley where Villa Ocampo is located, followed a small stream for some time, and finally turned away from it and entered a vast llano lying between the Sierra Guojolottes and the Sierra del Oro. Both of these mountains were covered with oaks. Continuing up the valley to the village of Encino we left the road and drove across the grasslands towards the Sierra Guojolottes until we reached a spring at the bottom of the oak-juniper zone. Our camp was at approximately 6200 feet elevation. The night was clear, cool, and windy, and collecting was poor.

Beyond Encino the valley reached an elevation of approximately 6500 feet. In this area much of the land was under cultivation. On crossing the divide at the head of the valley, the road drops off sharply into another valley where the town of Santa Maria del Oro is located at an approximate elevation of 5300 feet. From previous information we believed that a road led from del Oro to La Zarca, but the people in the town did not know about it, so back towards the llano we went. Fortunately we met a produce truck whose driver knew the country and could accurately tell us how to proceed to La Zarca. One of the passengers on top of the truck, a lad in his 'teens, volunteered to show us the correct road.

Eventually we regained the Encino llano, found our way across the grassland, skirted one village, and headed for a low pass in the mountains. Just before we reached the trees we came upon a small but deep little valley-like depression in which is located the village of Boquilla. From here we climbed a narrow road to an elevation of approximately 6900 feet. We passed through various types of vegetation, some grasslands, some regions dominated by shrubs, and one place completely covered by a dense thicket of



FIG. 24. "Jeep" being ferried across the Rio Nazas. In foreground are Mexican cypress trees; cottonwoods are in background.

junipers. Finally we came out on a vast undulating grassland known as the Meseta de la Zarca, where a modern highway was in the process of construction between Durango City and Parral. We wanted our guide to stay with us for the night, but he insisted on leaving, and he started off afoot across the plains at 6 P.M.; his home was at least 15 miles away.

That night we camped at Meseta de la Zarca at approximately 6400 feet in a small shrub growth of junipers and chollas. With the aid of our lights a good collection was garnered, including a

number of beetles of the genus *Monerilema* from the cactus and a new species of *Diplotaxis*, this latter species being endemic to Mexico. Also almost every cactus plant had webs of the orb-weaving spider of the genus *Metaperra*.

The next morning, July 29, we drove for 50 miles along a perfectly straight road with ranch land on either side. This vast meseta was all above 6000 feet in elevation. Apparently it was moist enough to support grassland, since Desert Shrub seemed absent. At the end of the meseta the road turned to the right, passed



FIG 25 Camp site at Rodeo, showing equipment and terrain

through rolling hills, and then dropped sharply into the valley of the Rio Nazas. The road down into this valley was unpaved but well graded. Once again we were in an arid, hot region, and the valley of the Rio Nazas was covered with Desert Shrub. Along the stream a dense human population dwells, depending on the stream for irrigation water. Willows, cottonwoods, and the huge Mexican cypress grow beside the stream. At the point where the road crosses the Rio Nazas, the elevation, according to a large sign on the bank, is 1380 meters, or 4527 feet. One by one our cars were taken across the river by a hand-powered ferry (fig. 24).

Late in the afternoon we completed the crossing, and now the road followed the river downstream for a number of miles. Upstream were rugged, spectacular mountains out of which the Rio Nazas flowed, but the country downstream consisted of a relatively broad valley filled with Desert Shrub. The soil was very rocky, and good camp sites were rare, but finally a suitable place was found just beyond the village of Rodeo (fig. 25).

This area was different from what we had seen previously. There were several chollas, including a "jumping cholla" with



FIG. 26. *Stenopais solitaria* Say. Photograph by Mr. George Bradt.

very slender stalks. Also, new species of platyopuntias were present as well as the usual numerous acacia, mesquite, and ocotillo. Night collecting yielded some moneilemas but was not otherwise good.

On the morning of July 30 the group collected in the near-by vicinity. Gertsch caught numerous specimens of an unusual butterfly belonging to the family Riodinidae, which were feeding on several flowering shrubs. In the meantime Bradt took pictures of a cerambycid beetle (fig. 26).

After following the river for a time the road turns due south at

the point where the Rio San Juan joins the Nazas. This tributary of the Nazas has cut a deep gorge where it flows into the valley of the Rio Nazas. The road partially follows this gorge for several miles and then leaves it completely and winds back and forth until it reaches a plateau region covered with mesquite, acacia, and yucca. A little farther west the grasslands begin to appear, and then suddenly the road drops again into the valley of the Rio San Juan. At this point the stream has carved out a great wide valley, leaving here and there mesa-like remnants standing high above the valley floor. One (fig. 27) is particularly striking. In-



FIG. 27. Mesa in valley of San Juan del Rio.

spection showed that the exposed strata consist of soft limestone. This valley is one of the most diverse and interesting that we had seen. Along the stream were cottonwood, willow, and cypress trees; on the near-by slopes were oaks, mesquite, and in the drier places chollas in abundance and, also, numerous platyopuntias. In some places the platyopuntias formed a veritable forest that covered many acres of land. The plants grew 15 to 20 feet in height with trunks over a foot in diameter. Probably this whole valley in its virgin state was a Cactus Savanna (Shreve, 1940). Irrigation and accompanying agriculture have greatly modified the area, but from here to the higher grasslands the dominant plants are the cacti. Much of the valley's land was under cultiva-

tion and probably had been for several hundred years. Considerable areas were irrigated, but some seemed to depend exclusively upon the rainfall. The irrigation system was extensive but definitely showed signs of deterioration. The main town of the valley is San Juan del Rio (fig. 28), which lies beside the river but several miles off the main road.



FIG. 28. Street scene in San Juan del Rio.

We camped near the foot of the hill leading into the valley on a terrace above the Rio San Juan (approximate elevation, 5200 feet). Here we stayed from July 30 to August 2. Insects of all sorts were abundant, but especially Cazier and Gertsch were happy over the great numbers of *Moneilema* (fig. 29) and trap door



FIG 29. *Moneilema* on cholla cactus Flash photograph by Mr. George Bradt.

spiders, respectively. In a dry, pasture-like area near camp were found numerous specimens of trap door spiders, all belonging to a single species of the genus *Eucteniza* (fig. 30). A local farmer not only knew about these spiders, but also showed an uncanny ability to spot the closed trap doors (fig. 31). Cazier also found literally thousands of tiger beetles (a subspecies of which occurs in southern Arizona) congregated in small grassy spots along the bottom of the terrace on which we were camped (fig. 32). Gertsch collected a primitive four-eyed spider of the genus *Nopsides*, previously known only from Cerrallo Island in the Gulf of California. Each night we went hunting for *Moneilema*. These creatures hide by day but come out at night to feed, mate, and lay their eggs on their host plants, the cacti, here for the first time we found the beetles in considerable abundance.

Biologically this valley seemed different from the regions in Chihuahua. It was hard to evaluate just what the differences were, and study of published temperatures and precipitation records gave few clues. Probably a mild climate, a long growing season, and a consistently uniform precipitation pattern may be mainly responsible. Arias (1942) gives data that show that the growing season at San Juan del Rio extends well into late October or even early November. The fact that orange trees were numerous in the protected gardens and patios of the town shows that the

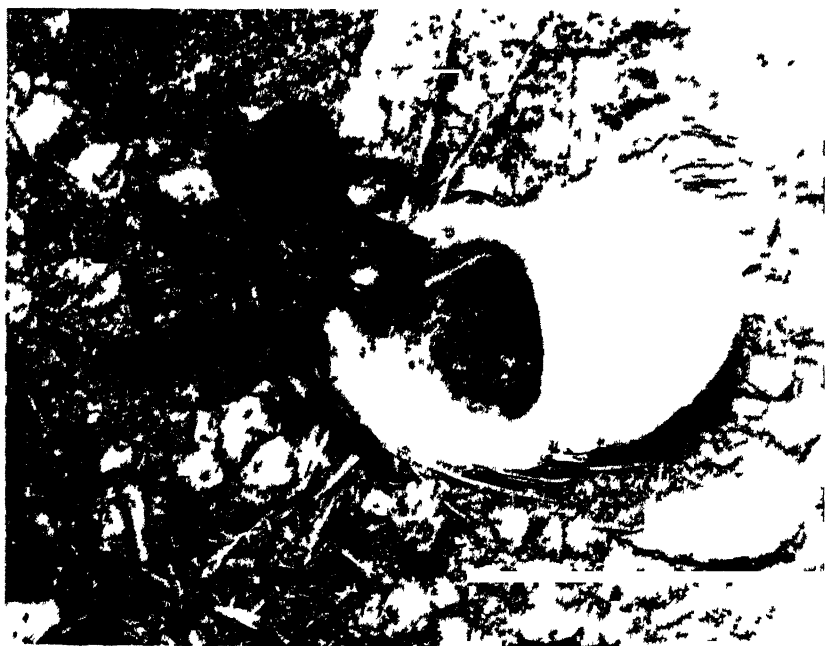


FIG 30 Trap door spider female Photograph by Mr. George Bradt

winters must not be too severe, although freezing temperatures are known to occur. Finally, it should be noted that the creosote bush seemed totally lacking. Obviously this whole area represents a broad transition between the Desert and the Cactus Savanna.

On August 2 we left the valley and headed southwestward through semi-arid country. Gradually the road went upward until, at approximately 6700 feet, we came out on a high, level grassland between two mountain ranges. The summer rains had been heavy in this area, and numerous marshy places and a lake, known



FIG. 31. Closed trap door of trap door spider domicile. Photograph by Mr. George Bradt.



FIG. 32. Cazier collecting tiger beetles at San Juan del Rio camp.

as Laguna de Santiaguillo, were seen in the center of the llano. Here there was a great deal of agriculture in addition to large herds of cattle. We got general collections, including trap door spiders of two genera, *Pachylomerides* and *Eucteniza*, and hundreds of beetles of the genus *Pelecyporus*. These latter creatures were crawling across the road, and we had only to pick them up. At an earlier stop on a semi-arid hillside we saw the openings in the ground that led into the nests of leaf cutter ants. Some of the en-

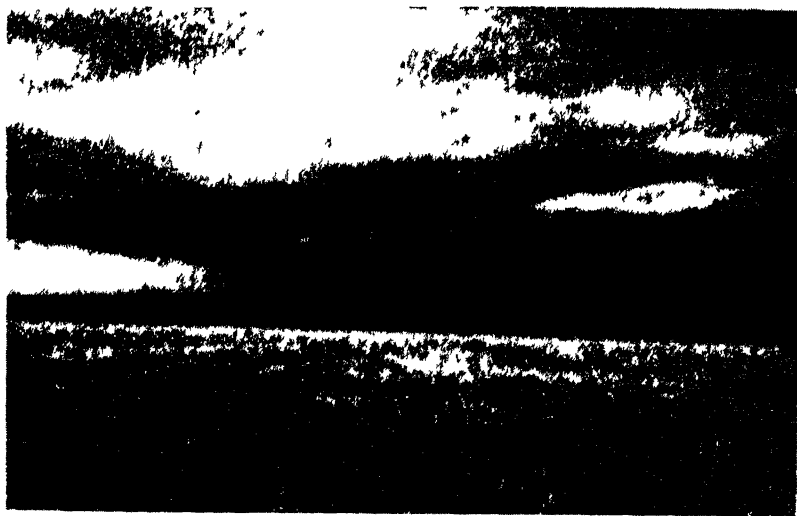


FIG. 33. Grassland on escarpment west of Durango, showing typical rainy season, late afternoon storm in background.

trances were fully 3 inches in diameter. Drainage was poor, and the road often passed through areas that were marshy at this time of year. In such places the road was well built up above the surrounding countryside. Gradually the terrain dropped in elevation and we were back again in the Cactus Savanna country. We passed through a few rolling hills and were on the outskirts of the city of Durango.

Sunday was spent in Durango and on Monday, August 4, we took the road westward towards Mazatlan on the Pacific. This time we knew we could get into the high Montane Forests of the Sierra Madre and we had hopes, faint ones it is true, that we might be able to traverse the mountains, drop down through the barrancas on the west side, and reach the Pacific. We knew roads

were being built through this area, but we could not learn just how far the construction had progressed. Mazatlan surprisingly enough is the closest Pacific port to New York City.

Durango (elevation 6226 feet) lies in the Cactus Savanna, but just west of town is a high escarpment that represents the eastern edge of the Sierra Madre Occidental. The gradient up the escarpment is steep, and within 25 miles an elevation of 8000 feet or more was reached. In doing so we passed through a narrow grassland zone (fig. 33), then through a fragmentary Oak Savanna, and finally into an area predominantly covered by pines with some oaks and junipers. Doubtless wood cutting, lumbering, and agriculture have modified the relationships of these zones to one



FIG 34. View at Palos Colorados, showing park-like area with grassland, oaks, and pines.

another, but it would seem that the effect of such activities has been the widening of the grassland zone at the expense of the woodlands. Westward into this high region runs a railroad from Durango to El Salto.

Twenty-five miles by road from Durango we camped at an elevation of over 8000 feet within a mile of a railroad siding and station called Palos Colorados. Here we found an amazing floral spectrum, the species of which grew side by side (fig. 34): oaks, three species of pines, madrono, manzanita, platyopuntias, small, barrel-type cacti, and grasses. The general appearance is now park- or savanna-like, but this is probably owing to the lumbering off of the original forest. Just how much of the present floristic

and faunistic pattern is due to the effects of man and how much to the interdigitating of the three vegetational types (that is, Cactus Savanna, Grassland, and Montane Forests) it is impossible to estimate. Since the rainy season was under way the grasses were growing rapidly, and the annuals were blooming in profusion. Among the many flowers were a beautiful white lily, probably *Calochortas*, a magnificent cosmos, and a small orchid.



FIG 35. Pair of individuals of *Plusiotis* sp. Photograph by Mr. George Bradt.

Collecting was excellent. Despite the rains and cloudiness Michener got goodly numbers of bees and also some interesting Lepidoptera, including many saturniids (*Automeris* and *Eupackardia calleta*) that came to the lights even during heavy rains. Gertsch collected the famous Durango scorpion and many other arachnid species. Cazier collected quantities of beetles, including numerous tiger beetles and a large series of *Plusiotis*. No longer were the moneilemas present, and our head-light collecting on the vegetation was mostly for the large and brilliantly colored *Plusiotis* (fig. 35) and dull-colored *Diplotaxis*. I found *Drosophila pseudoobscura* plentiful.

Here we also saw for the first time on the trip the famous madrono paper. On the limbs of the madrono trees (*Arbutus*) here and there were white to cream-colored, irregular, hollow, bag-shaped structures varying from a pint to a half gallon in size. There was always an opening on the under side. In many ways it was intermediate in construction between a tent caterpillar's tent and a hornet's nest. Actually it is the communal larval home of a butterfly, *Fucheria socialis* (fig. 36). A number of larvae spin the



FIG 36. Bag-shaped home of madrono caterpillars. Photograph by Mr. George Bradt

bag and eventually pupate inside. The pupae are naked, held to the inside of the bag by a few silken strands. The hole at the bottom allows the adult butterflies to escape.

Much rain fell while we were camped at Palos Colorados. Mostly the sky was partially filled with clouds, but some days during the morning the sun shone for variable periods. During the afternoons, the clouds built up and invariably covered the sky, and often rain fell. Nights usually brought more rains. The

elevation and the rains were sufficient to give us cool temperatures. Three nights, August 4, 5, and 6, we camped at Palos Colorados and on August 7 started on towards El Salto. West of Palos Colorados the elevation falls off as the Rio Chicos, a tributary of the Rio Mezquital, is approached. The elevation where the road fords the stream is something more than 7000 feet, and the surrounding area is grassland with oaks on the hillsides (fig. 37). The



FIG. 37. Bradt "jeep" crossing Rio Pico. In the background are grasslands with scattered oaks.

rains had raised the stream and, although it appeared to be falling, we debated whether it would be possible to get the vehicles across. The "carry-all" was our greatest concern and it was sent across first. The "jeeps" had no trouble (fig. 37).

West of the river and on the edge of the grassland and the mixed oak-pine woodland, at an elevation of approximately 7500 feet, lies the lumber town of Otinapa. Several miles west of Otinapa we came to an abrupt escarpment. On arriving at the top we were again at an elevation of over 8000 feet. From here to El Salto the country was one vast undulating region of alternating valleys and plateaus. Parts of the valleys were grasslands and often had small settlements with some surrounding agriculture. Despite the high elevation, frosts come late in this area, normally not until

late October or early November. Much of the corn was still less than 2 feet high when we saw it in early August. The plateaus were covered with pines and oaks. Where edaphic conditions were proper the oaks were the dominant trees. Finally there were the upland meadows, beautiful swales, covered at this time of year with masses of flowers. On one of these plateau areas we reached an approximate elevation of 8850 feet, the highest of the trip.

In the late afternoon of August 7 we camped about 6 miles east of the lumber town of Coyote. All during the day we had crossed



FIG. 38. Meadow near Coyote, Durango, showing summer flowers and pines.

and recrossed the railroad, and the vehicular road had become progressively poorer. Construction of a new road was going on both at Mazatlan and at Durango, but this central unimproved section was really poor. Our camp was made in a pine woods on the edge of a little valley. In the floor of the valley was a little meadow (fig. 38) where collecting was good. New species, some of them striking ones, appeared in the catches. Schramel got two specimens of a neotropical cerambycid. Michener and Gertsch discovered a beautiful *Argynnis* in the little meadow, and

Michener and Cazier each collected a female of this wily and elusive new subspecies representing a rare group which is found in the United States only in the extreme southwestern part of the country. I found *Drosophila* collecting good. Another species of *Plusiotis* (fig. 39), a Neotropical one, was discovered as well as a



FIG. 39. *Plusiotis* species taken at Coyote, Durango. Photograph by Mr. George Bradt.

couple of specimens of *Ergates* (fig. 40). Here also numerous tabanid, cyrtid, and cuterebrid specimens were taken. Night collecting was good, especially with the head lamps.

In the woods near the camp and by the meadow, woodmen were cutting pines with diameters of 9 to 12 inches. Having felled the trees, they immediately peeled all the bark and then cut the logs into about 8-foot lengths. We learned that these were to be used as mine props, but could not understand the reason for peeling the bark until we inspected the tree tops that were left behind and found that within a matter of a few days they were thoroughly infested by cerambycid beetles. Inspection of the countryside showed that cacti, both platyopuntias and small barrel types, were present. In addition to at least three species of pines, several species of oaks and some junipers were present.

The meadows were filled with blooming annuals of many species, and the whole countryside was bright with color. Late in the afternoon of our last day at Coyote a terrific rain storm hit the area, all night rain fell at a steady rate, not ceasing until early morning. During the night the temperature dropped to 59° F.



FIG 40. *Ergates neomexicanus* Casey, collected at Coyote, Durango

The Bradts now decided that they must leave us and return to Santa Barbara. As they turned back we pushed on towards El Salto. The road into Coyote was horrible, between Coyote and El Salto it improved somewhat but not much—it was full of holes, ruts, rocks, ledges, and soft spots. We were constantly concerned about either getting hopelessly stuck or cracking a crank case or gear housing. Late in the afternoon we camped in a pine woods overlooking a magnificent valley of pines and meadows (fig 41). Gertsch and I then drove one of the "jeeps" to the lumber town of El Salto (elevation 8325 feet) where a Mrs. Bishop at the lumber company's compound told us that we could go still farther west to



FIG. 41. Area just east of El Salto.

the edge of the barranca, but that the road to Mazatlan was not yet completed. Foiled again in our attempts to get into the barranca areas, we decided to return to Durango city.

Collecting at the El Salto camp was good, including a new sub-species of tiger beetle. Again we got *Plusiotis*, a different species than previously taken, plus a number of species of Tropical affinities. Apparently the Tropical fauna that lives along the coast at lower elevations pushes up the valleys onto the plateaus. At Palos Colorados we found few species of Tropical affinity, but as we worked westward these increased in number. This applied also to animals other than arthropods; for example, we saw parrots for the first time between Coyote and El Salto. Here at El Salto we found numerous species of insects of Tropical affinity. Gertsch, for example, found two phalangids of the family Cosmetidae, a group very sparsely represented in northwestern Mexico. In general the fauna of the region from Palos Colorados to El Salto appeared to be a mixture of Neotropical and Nearctic elements plus a number of Mexican endemics.

On August 11 we headed back for Durango, collecting at intervals along the way. The day was warm and clear, and many insects were active, especially those that visit flowers. We made a large collection of the flower-loving beetles of the genus *Acmaeo-*

dera, including the rare species *A. cuprina*, plus numerous other insects. We camped west of Otinapa that night in an Oak Savanna and the next afternoon reached Durango.

The trip west of Durango had been extremely productive.

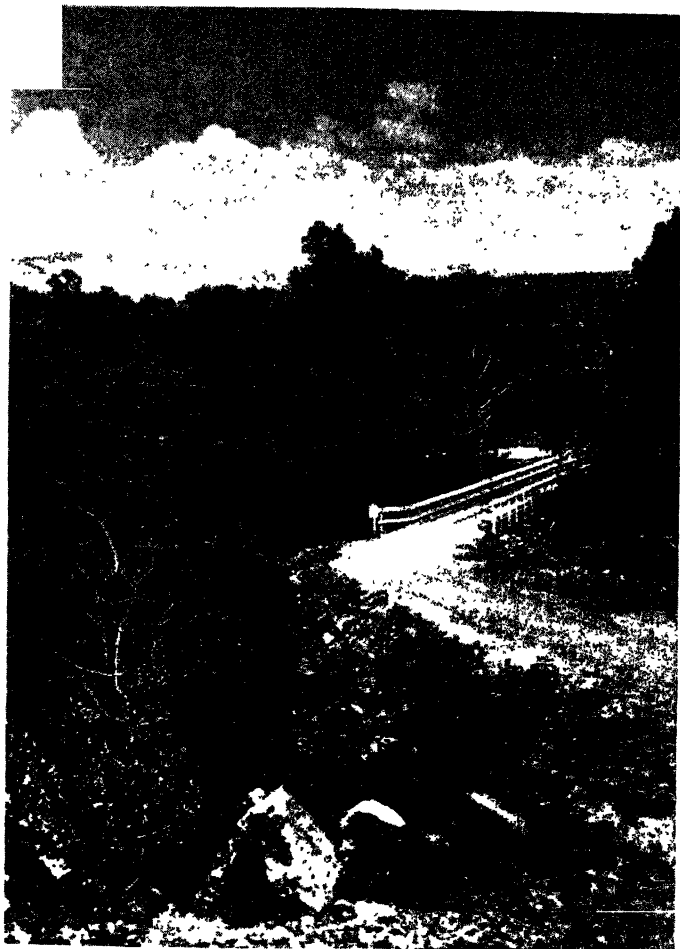


FIG. 42. Inside the gorge of the Rio Mesquital at Nombre de Dios.

Within nine days we had collected about 10,000 specimens, excluding living *Drosophila*, arachnids, and reptiles. Of the latter we had 20 different species, mostly snakes and lizards. Many insect species were taken for the first time on the trip, many repre-

sented rare or little-known species, and, finally, we had seen how the tropical and plateau faunas had interdigitated.

On August 13 we started southeast following a good, well-graded, modern road to Zacatecas, running through relatively level countryside, skirting along the north side of low mountains, and turning southeastward at the eastern end of the range. About 25 miles from Durango the road suddenly dropped down into a narrow, steep-walled little valley, almost a canyon, at the bottom of which lies the Rio Mesquital. This river drains the eastern face of



FIG. 43. Giant nopal cactus at Nombre de Dios.

the Sierra Madre and the area east of Durango, then turns and cuts back through the mountains south of Durango, and empties into the Pacific. The road crosses this river at the town of Nombre de Dios (figs. 42, 43). Here the river gorge is about 100 feet deep and 500 to 800 feet wide. The countryside, except for the irrigated parts, was Cactus Savanna and semi-arid, but the bottom of the gorge was semi-tropical. In the gorge were cypress trees, fig trees, tropical plants, leaf cutter ants, and other insects with obvious Neotropical affinities, while a wholly different fauna was found in the surrounding countryside. After collecting in the gorge for some time our clothes were wet from perspiration due to the high humidity, but they quickly dried in the just as hot but less humid areas above

the gorge. Naturally we wished to collect in these habitats and therefore located our camp near the river. Moneilemas were found, not in great numbers, but a species of *Tetraopes* was abundant, and I collected ephemerids in the river.

After collecting during the forenoon of August 14, we traveled southeastward through country that is rolling and arid, dominated mainly by cacti, mesquite, and grasses. Near the Durango-Zacatecas boundary the road rose steadily, following a broad valley until it topped a crest of approximately 8100 feet. On this upgrade we stopped near the town of Canutillo, Zacatecas, where pines, junipers, chollas, platyopuntias, yuccas, and oaks all form a savanna-like vegetation. The soil is very thin, and the underlying strata are limestone. We found embiids again, the first time since the collection taken at La Saucedá northwest of Santa Barbara. As we approached this valley we saw to the east a low range of mountains capped by spectacular saw-toothed formations. The road skirted to the south of these as it climbed to the top of the crest. Once across this height we were in a vast rolling plain in many ways similar to the Meseta de la Zarca. On the slopes there are some oaks, but the whole region is mainly one vast grassland, cultivated in the lower moist places and with cacti invading the drier areas.

Crossing this country we came suddenly upon a relatively narrow valley in which is located the city of Sombrerete (elevation 7708 feet), an ancient mining town, dominated by numerous huge churches. East of Sombrerete at Arenal we made a small roadside collection at an approximate elevation of 7900 feet. The vegetation here was mostly grassland, but a few oaks and numerous cacti were to be found. At Sain Alto, a number of miles farther on, we camped at an elevation of approximately 7000 feet. Now we were definitely in the Cactus Savanna again (fig. 44). The high rolling plains thus alternate between grassland and Cactus Savanna, with the grasslands at the higher elevations and in the more mesic situations. Mixed with the cacti were mesquites and other shrubs, on which grew numerous small epiphytes.

From Sain Alto to Fresnillo the country is relatively level and at an elevation of about 7000 feet. Just before reaching Fresnillo we came into an area dominated by large yucca trees that seemed similar to the Joshua trees of the southwestern United States. They were quite numerous and very spectacular. From these Schramel made good collections of weevils. The day was



FIG. 44. Cactus Savanna at Sain Alto.

bright and sunny and the bees were active so that Michener got a fine collection from the flowers along the roadside. Fresnillo (elevation 7380 feet), like Sombrerete, is a famous mining town. From Fresnillo to Zacatecas the road ran through an agricultural area, with the result that we found no good collecting.



FIG. 45 Area at Guadalupe camp.

On the outer edge of the neighboring town of Guadalupe we found a good camp ground. Here at an approximate elevation of 7400 feet in a primarily agricultural region was an open pasture which offered a likely collecting spot (fig. 45). Three species of platyopuntias (fig. 46) were growing in great numbers, plus

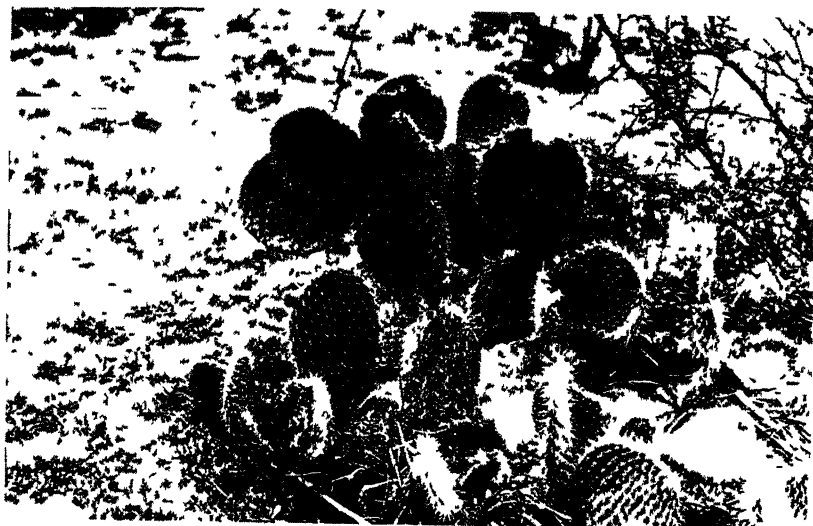


FIG 46 Small nopal cactus, showing feeding marks of *Moneilema*

numerous chollas (fig. 47), cat claws, acacias, desert gourds, many flowering annuals, and numerous large pepper trees, a couple of which served us well as shade for our camp. It was our first meeting on this trip with the "pepper" tree and clearly indicated that, despite the altitude, we were now in a milder climate than that farther north.

With all these cacti there must be moneilemas about, and as soon as darkness fell we donned the head lamps and started out in search of these fascinating black beetles. By midnight we had 73, of which Cazier got 31. Saturday, the sixteenth, was also spent collecting here. I had caught some *Drosophila* the evening before, and both the morning and evening catches on Saturday were excellent. Since the *Moneilema* collecting had been good, we decided now to inspect the countryside in preparation for making a really thorough collection Saturday night. Near by was a small village, and we noted that a large cactus patch was beside it.



FIG. 47. Cholla cactus, showing excrement from *Moneilema* larva.

Since the fruits of the large platypuntia are eaten and the young leaves are cooked for food, this cactus is of considerable economic importance to the natives and usually a number of plants are grown near the habitations. Collecting here and in the surrounding area netted 146 beetles that evening.

Sunday found us retracing our route to Durango. We had reached the southernmost limit of our trip and now planned to work north via Torreon and Saltillo towards the United States. That night we camped again at Nombre de Dios beside the Rio Mesquital, added to our collections, and on Monday, August 18, reached Durango. Between Nombre de Dios and Durango a



FIG 48 *Psiloptera drummondii webbi* LeConte Photograph by Mr George Bradt

roadside collection gave us a large series of bees belonging to the Tropical genus *Euglossa*. Again we were meeting with the interdigitating of the northern and southern faunas

The Durango-Torreon road leads northeast through a broad valley (elevation of from 6200 to 7000 feet) in which numerous small towns are located. The moister sections of the valley were under cultivation, while the drier places were grazing lands. At San Isidro, 60 miles from Durango, at an approximate elevation of 6700 feet, we camped on an open hillside. Here again cacti—

platyopuntias, small barrel types, and many chollas—were present. This whole valley seemed primarily to be a Cactus Savanna. Except for the mountain region west of Durango, we had been in a uniform type of environment ever since we entered the valley of Rio de San Juan: at higher elevations, grasslands with some oaks; at lower elevations, cacti; and at intermediate spots, a mixture of grasslands and cacti. A rain early in the night drove us from our collecting, but the next morning we were able to make a few additions, especially bees.

At Yervanis (approximate elevation 6700 feet), about 80 miles northeast of Durango, a fine roadside collection was made, especially bees, beetles, and trap door spiders of the genus *Pachylomerides*. Many female spiders were dug out of their holes, with numerous half-grown offspring which were atypically still in the burrows with them. Schramel also got several tarantulas after some laborious digging, and also numerous examples of two species of buprestids from the acacia plants (figs. 48, 49). The terrain seemed much more xeric than that at San Isidro, even though the elevation was almost similar. At 100 miles (by road) north of Durango the road dropped sharply into a broad, hot, arid valley. Here we came to the village of Cuencamé (elevation 5461 feet). Floristically the area was much like the valley of the Rio Nazas at Rodeo. Here again we found creosote bush, trembling cholla, and small agaves; thus we were now back in the Desert Shrub, having left the Cactus Savanna region when we descended the long grade into the town. Late in the evening we found a camp site near the town of Pedricena (elevation 4293 feet), where night collecting was fair and included a series of spiders and an enormous solpugid.

Since leaving Santa Barbara I had collected a great many *Drosophila*, mostly *pseudoobscura* and *azteca*, but in consideration of the previous disasters I had experienced with shipping the specimens I had decided to carry all subsequent collections with me. For this purpose I had constructed an insulated box which now became my chief concern, since the adult specimens could not tolerate more than 27° C. At each stop I placed the box in the coolest place I could find and also kept the box covered with a wet cloth, counting on the evaporation to keep it cool.

From Pedricena to Torreon the road descended gradually, going through increasingly arid country. Collecting along this stretch was good, especially for bees and some beetles (of Sonoran zone affinity). Shortly after lunch we reached the Rio Nazas just



FIG. 49. *Hippomelas caelata* LeConte. Photograph by Mr. George Bradt.

west of Torreon. Although a modern roadbed had been completed from Durango to Torreon and some of it paved, a bridge across the river was non-existent. We therefore had to follow a narrow and hideous little road along the south side of the river for a number of miles. In places it was filled with mud and water; in other places it went over steep hillsides, across rocky ledges, and down boulder-strewn gullies. Finally, without mishap, we arrived at Torreon (elevation 2560 feet).

East of Torreon lies Laguna de Mayran, a depression into which for millions of years the Rio Nazas has spilled its silt and now has almost filled the basin. Known as the "Laguna District" it has been turned into one vast, irrigated, agricultural area. Originally it was covered with a wilderness of *Prosopis*, *Atriplex*, *Suaeda*, and other halophytic plants, but now it is cultivated land, used chiefly for growing wheat and cotton. In addition to Torreon, which is on the edge of the irrigated area, a number of agricultural villages are located along the road just east of the city. Near one of these, San Pedro, we found an unirrigated, grass-covered region off the road where we camped in the midst of mesquites and oaks. Here night collecting, especially with the lanterns, was good, and Schramel chased a mature tarantula into its hole and then dug it out. From Samalayuca where Gertsch took the first specimens of tarantulas we had occasionally seen and taken examples of the group. Because of their habits only the mature males are seen walking about during the day.

From San Pedro the road swings to the south towards the northern flank of the Sierra de Baicuco, a dry, east-west oriented mountain that lies along the southern shore of Laguna de Mayran. We passed outliers of this sierra that were almost covered by the delta that had been laid down in the lake. Protruding from the vast level plain, these looked much like the upturned hulls of huge sunken ships. At various points along the road we stopped and collected. At the sides of the roads many annuals were in bloom, especially composites. At one place great masses of sunflowers grew along an irrigation ditch. At all these places we collected great numbers of giant grasshoppers, bees, beetles, flies, and some spiders. East of Laguna de Mayran the road runs through very arid desert, with the elevation rising gradually. For many miles the drainage is west into Laguna de Mayran so that these streams also have deposited their silt in the lake. For a hundred miles or so we drove through this country, which receives an annual average rainfall of 3 inches. There is sufficient water for mesquite only in the low spots. Much of the area is bare, and only a sparse cover of acacia, creosote bush, and agave is found. The human population is correspondingly thin. Here and there we saw a few people in temporary shelters, collecting the fibers of the agave. The highway is good, a well-paved road carrying a great deal of traffic between Torreon and the eastern cities of Saltillo and Monterrey. Low mountains running in an east-west

direction could be seen during the day south of the road, but in the late afternoon we could see a solid range of mountains ahead of us that ran north and south. These we knew were the Sierra Madre Oriental. In the late afternoon we found a camp site (approximate elevation 4000 feet) near the village of Cabos just a few miles west of the Sierra Madre. Here there seemed to be a bit more moisture; large mesquite trees were growing in some spots, and some land was under cultivation with the use of dry farming techniques, since not enough permanent water was available for irrigation. Coming across the desert we had at various stops collected monilemmas. At the Cabos camp there were numerous cacti, especially cholla, and, true to expectation, we got a good collection of the beetles.



FIG 50 Terrain just west of Saltillo

On the morning of August 22 we collected for several hours and then started eastward. Seemingly the mountains we were approaching were one vast impenetrable mass, but when we reached them we found that the road ascended a relatively broad valley surrounded by almost barren mountains. We climbed gradually to about 5600 feet (fig. 50) and then suddenly on the other side, lying nestled in a broad valley surrounded by mountains, we saw the beautiful city of Saltillo (elevation 5278 feet).

From Saltillo we took the road to Piedras Negras by way of Monclova. Some distance out of the city we found a camp site in an area dominated by mesquite and creosote bush. Here were a number of species of cacti, especially echinocacti, which we had not seen previously on the trip. That night a specimen of *Saturnia* (*Agopema*) *galbina*, a pretty little saturniid moth, came to light. Clearly we were now entering another type of vegetation from that previously encountered. It was difficult to say just what the change was, but we all recognized it. Obviously this area receives more rain than the basin to the west, which we had just passed through, and, although we were still in semi-arid to arid country, there was enough moisture for dry farming in the lower places. According to Arias (1942), Saltillo receives 13.34 inches of precipitation, while Ciudad Lerdo (just west of Torreon) receives 9.6 inches.

On August 23 we broke camp early in the morning and started northward. The road ran through low mountains, which bore very scanty vegetation. Gradually the elevation decreased, and within 30 miles we had dropped to approximately 3100 feet. With the decreased elevation for a time the countryside seemed drier, but 60 to 70 miles (by road) north of Saltillo the mountains became much lower, were dispersed with broad valleys, and the vegetation was much denser. Summer rainfall in these regions is torrential, and all along the route most of the bridges, huge reënforced concrete structures spanning tiny stream beds, had been completely washed out.

Along the sides of the pavement great masses of annuals were in bloom. Joshua tree yuccas appeared and great masses of mesquite. Shreve (1942) notes that this area "combines the characteristics of the desert with those of the arid brushlands of Tamaulipas." Now we decided to try a new method of collecting. There was little traffic on the road, so the passenger in each "jeep" was given a net and, while the driver drove very slowly, the net was swept through the mass of flowers growing beside the pavement. Occasionally we stopped, shook out the larger pieces of vegetation, and dumped the remainder of the catch into large cyanide jars. The method was successful, and over a stretch of 10 to 15 miles we collected several thousand specimens.

After passing through the beautiful Cañon de San Lazaro we entered a still more mesic area with relatively heavy vegetation. That evening, August 23, we camped south of Monclova near the

town of Gloria at an approximate elevation of 3000 feet in a dense thicket (fig. 51). Here collecting was excellent, and Gertsch and Michener collected numerous examples of diurnal Lepidoptera. Cazier as usual was the expert on moneilemas, getting 127 the first night, while the rest of us got 119, for a total of 246. The temperature and humidity were high, and I had great trouble keeping the *Drosophila* box cool. The next day investigation showed the flora to be an amazing combination of creosote bushes, large yuccas, mesquites, and many cacti, plus many bushy and



FIG 51 Vegetation at Monclova camp

herbaceous flowering plants. Orange butterflies of the genus *Anaea* were rather abundant. We spent all August 24 collecting here. Previously, as we had crossed from Durango to Saltillo, we had found a few moneilemas sitting on chollas during the day, which was surprising as they normally hide by day and come forth to feed, copulate, and oviposit on the cacti only at night. Here we found numbers of them sitting on the chollas, and, in spite of a heavy thundershower during the evening, we made a large collection, giving us almost 600 specimens of the genus at this single locality.

Early next morning we broke camp and, after a short stop at Monclova, headed for the United States-Mexican border. Occasionally that day we made short stops to collect, and late in the

afternoon we reached Piedras Negras, passed through customs, and into Eagle Pass, Texas. Monday morning the long trek homeward was started, and, by driving hard, we reached New York at noon, Sunday, August 31.

SUMMARY

In 11 weeks we collected over 100,000 specimens of insects and arachnids, plus several hundred reptiles of various sorts. The collections were made from a variety of major habitats: the bolson area of Chihuahua with its Desert Shrub and Desert Grassland, the woodland oak region, the high llanos, the Montane Forest, the Cactus Savanna, the extremely arid desert of Coahuila, and finally the mesquite bush area around Monclova.

Utilizing the biotic provinces as set forth by Dice (1943), we collected extensively in three provinces, i.e., the Apachian, the Durangan, and the Chihuahuan, and touched the edges of the Potosian and Tamaulipan. The Chihuahuan, which embraces the Chihuahua Desert as mapped by Shreve (1942), was crossed twice, from El Paso to Santa Barbara and from Cuernavaca to Saltillo. Collections were made where it merged with the grasslands on the west, with the Cactus Savanna on the southwest and south, and with the mesquite on the east. By themselves, these collections are of great biological value not only because they contain many new species and subspecies, but also because of the information they give concerning the interrelationships of the faunas, showing how the Tropical and Temperate faunas interdigitate and also indicating the relationships of the insect faunas to the question of the biotic provinces. The subsequent papers that are now in preparation will discuss these matters fully. Suffice it to point out here that in *Drosophila pseudoobscura*, which was studied by Dobzhansky (1948), it was shown that this area contained a new chromosome pattern and also that a remarkably steep gradient of change must exist between the *pseudoobscura* population of the high plateau area and that of the region immediately to the south.

Valuable as these collections are, their intrinsic worth will be considerably increased if in subsequent years collections can be made along the western side of the Sierra Madre Occidental, across the great transvolcanic region south of Zacatecas, and along the eastern side of the Sierra Madre Oriental. This expedition tapped the heart of the Mexican plateau area. Collections from the

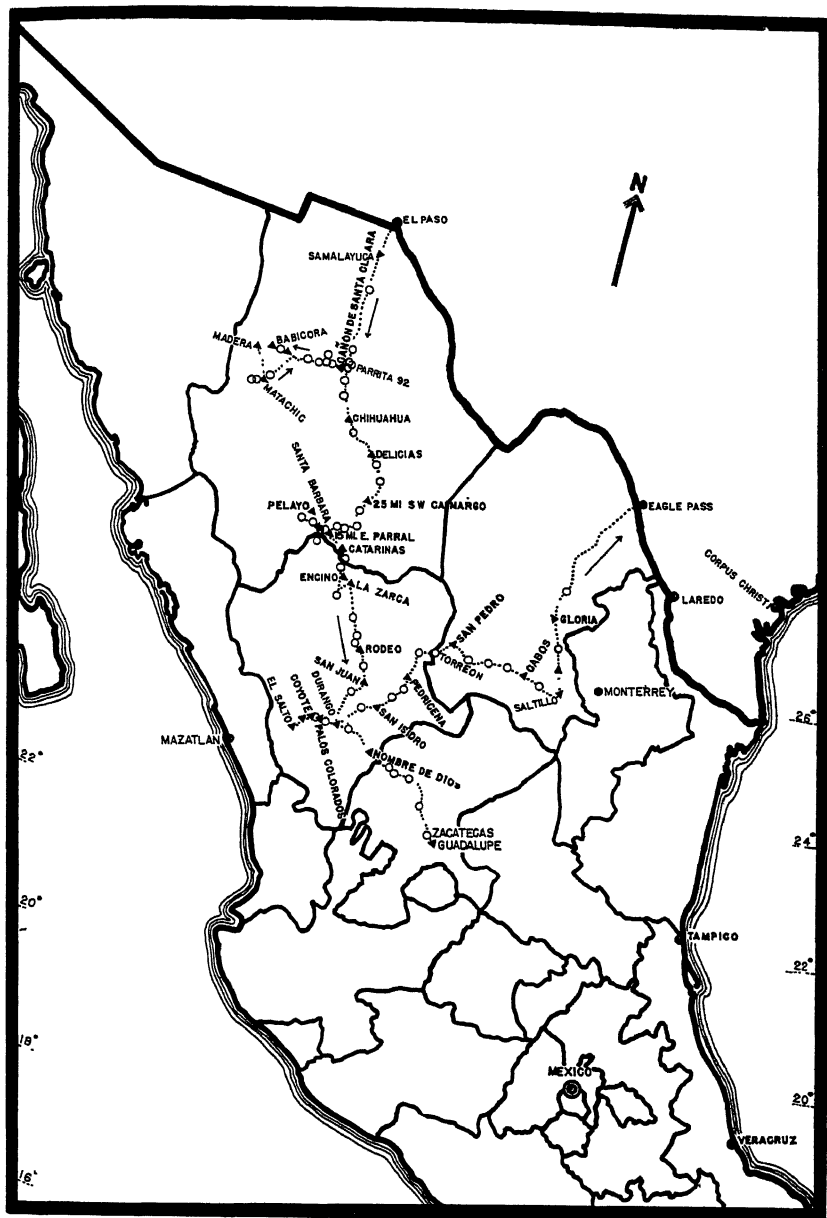


FIG. 52. Map showing route and more important stops. ▲ indicate over-night or longer stops. ○ indicate the more important temporary collecting spots.

three flanks and especially from the barrancas of the Sierra Madre Occidental would add immeasurably to the value of what has been collected on this expedition.

Through the kindness of Dr. David Rockefeller the collections are now prepared for study and will be made available to specialists. It is hoped that through a study of this material, correlated with that from the United States and other sections of Mexico, a better understanding of the relationships between the Nearctic and Neotropical faunas will be gained.

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THREE NEW VENEZUELAN BIRDS¹

BY JOHN T. ZIMMER AND WILLIAM H. PHELPS

Further examination of the Venezuelan birds in the American Museum of Natural History and the Phelps Collection, Caracas, Venezuela, has shown the following undescribed forms, consisting of one new species and two new subspecies.

In the lists of specimens examined, those in the Phelps Collection are so characterized; the remaining material is in the American Museum of Natural History.

Names of colors are capitalized when direct comparison has been made with Ridgway's "Color standards and color nomenclature."

Acestrura heliodor meridae, new subspecies

TYPE: From Páramo Conejos, State of Mérida, Venezuela; altitude 4000 meters. No. 484853, American Museum of Natural History. Adult male collected May 17, 1897, by "S. Briceño Gabaldón é hijas."

DIAGNOSIS: Differs from the other subspecies of *heliodor* (*cleavesii*, *heliodor*, and *astreans*) by having a darker, more purplish, less reddish throat.

RANGE: Known from the upper Subtropical, Temperate, and Páramo Zones in the Mérida region, at altitudes between 2000 and 4000 meters.

DESCRIPTION OF TYPE: Upper parts Cossack Green, with a white patch on the sides of the lower back; tail-coverts more dusky; a white postocular stripe broadening posteriorly on the sides of the neck. Chin and throat between (True) Purple and

¹ Previous papers in this series by the same authors are American Museum Novitates nos. 1270 (1944), 1274 (1945), 1312 (1946), 1338 (1947), 1373 (1948), 1395 (1949), and 1412 (1949).

Rood's Violet, the lateral throat feathers greatly elongated; sides of neck white; breast pale grayish, more whitish anteriorly, merging laterally into the white of the neck; rest of under parts Diamine Green. Remiges near Seal Brown; upper wing-coverts uniform with the back; under wing-coverts and axillaries uniform with the abdomen. Tail Blackish Brown (2), with the rectrices long and narrow. Bill (in dried skin) black; feet brown. Wing, 29 mm.; tail, 19; exposed culmen, 13; culmen from base, 14; tarsus 3.5.

REMARKS: Sexes unlike in coloration and size. Description of adult female (No. 484884): Top of head, back, and rump Spinach Green; a white patch on sides of lower back; lower rump and upper tail-coverts dark Sanford's Brown, forming a broad band and with a green spot in the center of some of the posterior feathers; lores, ear-coverts, and malar stripe dusky; a small whitish spot at upper posterior border of the orbit. Chin, throat, and sides of neck Pinkish Cinnamon merging into the dark Sanford's Brown of the flanks, sides of abdomen, axillaries, and under tail-coverts; middle of abdomen a little paler; anal region white. Wings darker than Warm Blackish Brown; upper coverts uniform with back; under coverts greenish. Tail Cinnamon-Rufous, paler on under surface, with a broad black band across the center and with a slight trace of green just preceding the dark band on the median feathers; rectrices short and rounded, entirely different from those of the male.

Size similar to that of *heliodor*. The female has a longer wing and bill. Measurements: five adult males, including type: wing, 28-29 mm. (average 28.5); tail, 19-20.5 (19.3); exposed culmen, 12-13 (12.4); five adult females: wing, 33-35 (33.7); tail, 14-16 (15.1); exposed culmen, 13.5-14 (13.9). Measurements of *heliodor* from "Bogotá": five adult males: wing, 27.5-29 (28.3); tail, 18-20 (19.0); exposed culmen 12-13.5 (12.4); five adult females: wing, 33-35.5 (40.0); tail, 15-16 (15.4); exposed culmen, 13-14 (13.5).

Both Boucard and Simon comment on the Mérida birds as having a darker, more purplish throat than the Bogotá ones. Boucard (1892, *Genera of humming birds*, p. 16) says, "...the color [of the throat] is of a more metallic lilac red; but I doubt very much if this is sufficient to consider it a distinct species." Simon (1921, *Histoire naturelle des Trochilidae*, p. 239) says, "...ne diffère pas de celui de Bogotá sauf parfois par la plaque jugulaire d'un rose un peu plus bleu."

Simon calls attention to the fact that Boucard misidentified his "several" specimens from Mérida as the species *decorata* which Peters (1945, Check-list of birds of the world, vol. 5, p. 139) lists as "Known only from the unique type" and "supposed to be from Antioquia in Colombia." Gould's plate (1861, Monograph of the Trochilidae, vol. 3, pl. 146 and text) shows that the throat plumes of the type of *decorata* are very much shorter than in *heliodor*, forming a rounded, not pointed, pattern and that the color of the throat is still redder, less purplish, than in *heliodor*. Consequently this name is not available for the Mérida bird.

The immature specimens present a somewhat confusing picture, from which it is impossible to draw exact conclusions because of inadequate sexing of the material examined. Descriptions of the various styles of plumage are as follows:

- A. Throat and belly dull, light cinnamonaceous, with traces of indistinct spots on the throat; sides of breast whitish; flanks with a dull greenish tone; tail as in the adult female, but colors dull.
- B. Throat deeply cinnamonaceous, crissum paler; a whitish band across the breast and sides; lower under parts green; tail as in adult male.
- C. Throat white or with a variable cinnamonaceous wash, usually with various purple feathers appearing in places; breast whitish; lower under parts deeply cinnamonaceous but usually with green feathers appearing on the flanks; tail with somewhat narrower feathers, finely tipped with rufous, intermediate in appearance between those of adult males and females.
- D. Throat and breast white with a slight buffy tinge and with scattered purple feathers as in C; lower under parts dark green but crissum and middle of belly sometimes light rufescent; tail as in adult female.
- E. Like D, but tail as in adult male.

It is impossible to trace any clear succession of plumages through this assemblage. Furthermore, except for the birds here described, there is no example among the 15 immature specimens in this series that seems clearly recognizable as an immature female, making it quite probable that one or more of the plumages here described belongs to that sex.

In view of the fact that plumage C shows the tail approaching that of the adult male, C is probably an immature male stage as are B and E. The only plumages left for young females are A and D, and if D is correctly assigned to the female, it suggests (through its possession of some purple feathers on the throat and the green belly) that some adult females may resemble the males. Such condition has been suspected and even demonstrated among other hummingbirds and may be more common than is known at present.

In any case, the suggestion is made here and awaits substantiation by an adequate series of carefully sexed young birds. There is still much more to be learned about the immature plumages of hummingbirds.

SPECIMENS EXAMINED

A. h. astreans.—COLOMBIA: El Mamón, Santa Marta region, 1 ♂; Valparaíso, 1 ♀; "Colombia," 2 ♂.

A. h. heliodor.—COLOMBIA: "Bogotá," 15 ♂, 9 ♀, 1 juv.; "New Grenada," 2 ♂, 2 ♀, 2 juv.; "Colombia," 2 ♂; La Tigrera, Cauca, 1 ♀; San Agustín, Huila, 1 "♂" juv. No locality, 1 ♂, 4 ♀.

A. h. cleavesi.—ECUADOR: Río Oyacachi, below Chaco, 1 ♂, 4 ♀; Baeza, 1 ♂.

A. h. meridae.—VENEZUELA: El Valle, Mérida, 1 ♂, 1 juv., 4 ♀, 1 ♀¹; Páramo Tambor, 4 ♂, 6 juv.; Páramo El Escorial, 4 ♂, 1 ♂¹, 1 juv.; Páramo La Culata, 1 ♀; Páramo Conejos, 2 ♂ (including type), 2 ♂¹, 1 juv.¹; Páramo Pinos¹, 1 ♀, 1 juv.; Páramo Nevados, 1 juv.; Venezuela, 1 ♀; no locality, 1 ♀¹.

Picumnus spilogaster orinocensis, new subspecies

TYPE: From Altagracia, Orinoco River, State of Bolívar, Venezuela, No. 488839, American Museum of Natural History. Adult male collected January 27, 1898, by George K. Cherrie.

DIAGNOSIS: Differs from *P. s. spilogaster* of British Guiana and northern Brazil by having paler brown back and rump and uniformly unspotted under parts.

RANGE: Known only from Altagracia and Caicara on the south bank of the lower Orinoco River, Venezuela.

DESCRIPTION OF TYPE: Back and rump Dresden Brown, the feathers with indistinct bars giving a slightly mottled appearance; upper tail-coverts whitish; occiput and supra-ocular region blackish, finely spotted with white; crown and forehead Scarlet, the bases of the feathers black; nasal patches brownish gray; ear-coverts pale brownish with indistinct, whitish cross bars; malar region whitish with fine dusky tips to the feathers. Below whitish with a slight buffy tinge, deeper on the belly; a few inconspicuous, pale brownish spots on sides of breast. Wings Benzo Brown; primaries and outer secondaries finely edged with paler, and inner secondaries and tertials very broadly edged with buffy; inner vanes of remiges edged with pale buffy; upper wing-coverts dusky brown, narrowly edged with paler brownish, uniform with the back; under wing-coverts and axillaries buffy white. Tail

¹ Specimens in the Phelps Collection, Caracas.

black; median pair of rectrices with white inner webs; outer two pairs with a broad whitish diagonal band crossing both webs in advance of the dark tip, broader on the outer web. Bill (in dried skin) horn color, base of mandible paler; feet blackish. Wing, 56.5 mm.; tail, 31; exposed culmen, 13; culmen from base, 15; tarsus, 14.

REMARKS: Sexes alike except that the female lacks the reddish orange crown, the whole top of head being black with small white spots.

Size similar to that of *spilogaster*. Range of measurements: type and four other adult males: wing, 51–56.5 mm. (average, 53.1); tail (4), 29–31 (29.8); culmen from base, 14–15 (14.4); six adult females: wing, 51.5–55 (53.2); tail, 28.5–30 (29.3); culmen from base, 14–15 (14.3). Measurements of *spilogaster*: three adult males: wing, 53–57 (54.8); tail, 29–33.5 (31.0); culmen from base, 12.5–15 (13.6); two adult females: wing, 56–58 (57.0); tail, 30.5–31.5 (31.0); culmen from base, 14–14 (14).

Peters (1948, Check-list of birds of the world, vol. 6, p. 95) has synonymized *Picumnus spilogaster* Sundevall (1866, Conspectus avium picinarum, p. 100; "Guyana") with *P. minutissimus* Pallas (1782, Neue Nordische Beyträge, vol. 3, p. 5, pl. 1, fig. 2; Surinam and Cayenne) but we do not agree, as five specimens at hand, which agree closely with Sundevall's description, are entirely different from *minutissimus* and do not show any approach to the squamulated under parts of that species.

We have synonymized *P. leucogaster* Pelzeln (1870, Zur Ornithologie Brasiliens, p. 335; Forte do Rio Branco, Rio Cauamé, Brazil) with *P. s. spilogaster*, because four of the present series are from Frechal, Brazil, and show a complete gradation from relatively immaculate under parts as described for *leucogaster* to the prominently spotted lower breast, sides, and abdomen, and strongly barred throat of typical *spilogaster*. The type locality of *leucogaster*, Forte do Rio Branco, is about 70 miles south of Frechal.

It is noteworthy that, notwithstanding much collecting, the species has not been obtained in the region between the lower Orinoco River in Venezuela and the upper Rio Branco in Brazil.

SPECIMENS EXAMINED

P. s. spilogaster.—BRITISH GUIANA: 1 [♂]. BRAZIL. Frechal, Rio Surumú, 2 ♂, 2 ♀.

P. s. orinocensis.—VENEZUELA: Altagracia, 1 ♂ (type), 1 ♀; Caicara, 4 ♂, 5 ♀.

***Picumnus nigropunctatus*, new species**

TYPE: From Araguaimujo Mission, Orinoco Delta, Venezuela. No. 48362, Phelps Collection, Caracas. Adult male collected March 5, 1949, by Ramón Urbano. (Type on deposit at the American Museum of Natural History.)

DIAGNOSIS: Differs from all other species of *Picumnus* by having the breast as well as the flanks and sides of belly with rounded dark spots on a light ground.

RANGE: KNOWN only from the unique type.

DESCRIPTION OF TYPE: Back and rump dusky, the feathers broadly edged with greenish yellow, giving a squamulated appearance; upper tail-coverts more yellowish; occiput and nape black, finely spotted with white; crown black, finely streaked with Scarlet-Red; forehead, against the bill, buffy white; sides of neck yellowish buff with dusky tips. Chin whitish, throat more buffy with narrow dusky tips anteriorly; breast, sides, flanks, abdomen, and under tail-coverts Straw Yellow × Naples Yellow, finely marked with slightly elongated, prominent black spots, absent on lower abdomen. Wings Benzo Brown; primaries narrowly edged, and secondaries, tertials, and greater upper wing-coverts heavily edged, with pale greenish yellow uniform with the back; median coverts with bright yellowish tips (almost forming spots) preceded by a blackish central marking; lesser coverts with dull yellowish terminal dots; under wing-coverts and axillaries buff; inner webs of remiges narrowly edged with greenish white. Tail black, inner webs of median rectrices yellowish white; on the outer two pairs a patch of yellowish white occupies the terminal part of the outer web, crossing diagonally to the inner web, more narrowly on the external pair. Bill (in life), "black, base whitish gray"; feet, "greenish gray"; iris, "dark." Wing, 49.5 mm.; tail, 23.6; exposed culmen, 12; culmen from base, 12; tarsus, 13.

REMARKS: This new bird does not seem to have any close relative to which it might be compared. In the general dorsal coloration and pattern it shows some similarity to *P. e. exilis* of southeastern Brazil, but the under parts are quite different. Probably it is best listed adjacent to *exilis*.

SPECIMENS EXAMINED

Specimens in the American Museum of the following species of *Picumnus* were examined: *cinnamomeus*, *rufoventris*, *castelnau*, *olivaceus*, *granadensis*, *exilis*, *borbae*, *aurifrons*, *temminckii*, *cirratus*, *spilogaster*, *sclateri*, *steindachneri*, *squammulatus*, *minutissimus*, *albosquamatus*, *guthriei*, *varzeae*, *pygmaeus*, *pumilus*, and *innominatus*. The type was further compared with descriptions of *fuscus*, *limae*, *nebulosus*, *pallidus*, and *asterias*.

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NOTES ON SOME INDO-AUSTRALIAN MONITORS (SAURIA, VARANIDAE)

BY ROBERT MERTENS¹

During my visit to the American Museum of Natural History in the summer of 1949, Mr. Charles M. Bogert, Chairman and Curator of the Department of Amphibians and Reptiles, generously placed the lizard material of the genus *Varanus* at my disposal for examination. I was especially interested in the collections from New Guinea and the near-by islands of the D'Entrecasteaux Archipelago. Inasmuch as an undescribed form as well as other noteworthy material were found in the collections, it was suggested that a report be made to supplement our knowledge of this group of lizards. In this paper, I should also like to report on the type specimen of *Varanus scutigerulus* Barbour from Sarawak, which was made available to me during my visit to Cambridge, Massachusetts, through the kindness of Mr. Arthur Loveridge, Curator of Herpetology at the Museum of Comparative Zoölogy. In addition to expressing my appreciation to Mr. Bogert and Mr. Loveridge, I should also like to extend my thanks to Mrs. Bessie Matalas Hecht of the American Museum for assistance in preparing the manuscript.

Loveridge (1948) in his valuable paper on reptiles and amphibians of New Guinea lists four species for this island, all of which are represented in the American Museum collections. They are *Varanus gouldii*, *V. i. indicus*, *V. p. prasinus*, and *V. salvadorii*. Now we can add two more species: *V. timorensis orientalis*

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and one previously unknown but shortly to be described on the basis of material in the collection of the Chicago Natural History Museum. From the neighboring islands Loveridge (1948) listed two endemic subspecies: *V. indicus kalabeck* from Waigeu and *V. prasinus beccarii* from the Aru Islands. We can now double the list by adding *V. prasinus kordensis* from Kordo (Korido), Schouten Islands north of Netherlands New Guinea, and a new subspecies described herein from Fergusson Island, D'Entrecasteaux Archipelago.

***Varanus salvadorii* (Peters and Doria)**

A.M.N.H. Nos. 59873, 59932: Two adults from Sturt Island, Fly River, Papua, collected by the Archbold New Guinea expedition in 1936.

A.M.N.H. Nos. 61884 (subadult), 61895 (adult), from Hollandia, Netherlands New Guinea, collected by Mr. W. B. Richardson of the Archbold New Guinea expedition in June–July, 1938.

There are four specimens of this rare species, of which only the skins and skulls are preserved. The occurrence of this species on Sturt Island in the Fly River (approximately 100 kilometers from the mouth) was not known, but it has been reported from Hollandia (de Jong, 1927, p. 310). One individual from Sturt Island is extraordinarily large, about 2 meters long, the skull being approximately 14 centimeters in length. Inasmuch as the skull of this species is known only from a young individual, I hope to give a detailed description of this large skull at a later date.

***Varanus timorensis orientalis* Fry**

A.M.N.H. Nos. 57884, 57885, 57888, 57890 (four females); 57886, 57891 (two males); 57887 (subadult) from Dagwa, near Daru, Western Division, Papua, collected by the Archbold New Guinea expedition in February, 1934.

A.M.N.H. Nos. 57892–57893 (two males), from Wuroi, Western Division, Papua, collected by the Archbold New Guinea expedition in 1933–1934.

A.M.N.H. No. 58391, one juvenile from "New Guinea" collected by the Archbold New Guinea expedition in 1937.

A.M.N.H. No. 59931 (female), 59956 (male), from Tarara, British New Guinea, collected by the Archbold New Guinea expedition in 1937.

A.M.N.H. No. 62884 (female) from Darril Station, Queensland, Australia, collected by the Whitney South Sea Expedition.

This material confirms my suggestion (1942, p. 303) that the *V. timorensis* reported by de Jong (1927, p. 311) from two villages, Gelib and Okaba, in southern New Guinea, were really the north-eastern Australian race, *V. timorensis orientalis*. The New Guinea material listed above agrees well with previously examined series of nine specimens of this subspecies from northwestern Australia; there are no pattern differences, but only some minor differences in the average number of dorsal and ventral scales. The adult males have a distinctly ocellated pattern, whereas in most females the ocellated pattern is diffused by light spots. The tail length is never twice as long as the snout-to-vent length as is characteristic of *V. timorensis tristis*. A female, A.M.N.H. No. 62884, from southwestern Queensland approaches *V. timorensis tristis* in having a dark-colored head, a very thick tail, and a high number of scales.

***Varanus prasinus bogerti*, new subspecies**

TYPE: A.M.N.H. No. 41639, adult male from Fergusson (Moratau) Island, D'Entrecasteaux group, collected by R. H. Beck of the Whitney South Sea Expedition in March, 1929.

PARATYPES: A.M.N.H. Nos. 41638 (female), 41640 (male) with the same data as the type.

DIAGNOSIS: A *Varanus* of the *prasinus* group, nearest the typical subspecies, but distinct in having rugose head scales, nuchal scales that are tuberculated, and a higher number (44-48 instead of 32-42) of occipital scales over the back of the head from rictus to rictus. The color is black as in *V. p. beccarii*, but from which it may be distinguished not only by the above-mentioned characters, but also by the posterior position of the nostril, the higher number of scales around the body (95-99 instead of 81-86), and the higher number of transverse series of ventral scales (87-90 instead of 70-79).

DESCRIPTION: Head long, narrow, 2.01 to 2.14 times as long as broad and 2.37 to 2.56 as long as high; snout long, pointed. The distance from the tip of the snout to the anterior border of the eye is somewhat longer than the distance from the anterior border of the eye to the anterior border of the tympanum. The canthus rostralis is indistinct and very slightly raised above the

nostril. The nasal openings are oval and distinctly nearer to the tip of the snout than to the anterior border of the eye; the snout-to-nostril distance divided by the nostril-to-eye distance provides a ratio varying from 1/1.15 to 1/1.29. The ear opening is large, the legs are long, and the fingers and toes are provided with strongly curved claws. The tail is long, twice as long as the

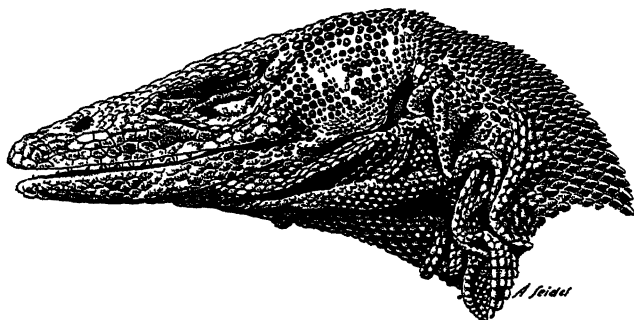


FIG. 1. Lateral view of head of the type of *Varanus prasinus bogerti*, A.M. N.H. No. 41639, adult male from Fergusson (Moratau) Island, D'Entrecasteaux group. Natural size.

snout-to-vent length, not compressed laterally, and with the end apparently somewhat prehensile. The skull (not examined) apparently does not differ in any important way from that of *V. p. prasinus*. The total length of the type is 830 mm.

LEPIDOSIS: The top of the head is covered with rather large scales which are largest in the interorbital region and the structure of which is rugose (less so in A.M.N.H. No. 41638). On each side there are three supraoculars slightly differentiated from the other head scales. A differentiated interparietal is present only in A.M.N.H. No. 41640. The temporals are smaller than the scales in the occipital region, numbering about 44–48 over the back of the head from rictus to rictus. Behind the mental there are no differentiated chin shields. The anterior nuchals, rounded and tuberculated, are smaller than the scales in the occipital region. The dorsal scales are very small, with exceptionally strong keels, and the ventrals are also strongly keeled. There are 95–99 scales around the middle of the body. The lateral scales are scarcely smaller than the dorsal scales. The ventral scales are in 87–90 transverse series from the gular fold to the insertion of the hind legs. The scales in the dorsal region of the

legs are keeled; those on the dorsal and ventral surface of the tail are approximately of equal size and in regular annuli to the tip of the tail. The two paratypes have pea-sized swellings scattered over the body which are caused by parasites.

COLORATION: The dorsal surface of the head and body is coal black without any pattern; the under side of A.M.N.H. No. 41638 is coal black, but in the other two specimens the color is somewhat lighter, or slate colored.

MEASUREMENTS: The measurements (in mm.) and scale counts of the specimens are as follows:

	TYPE	PARATYPE	PARATYPE
A.M.N.H. No.	41639	41638	41640
Total length	830	805	825
Tail length	555	545	550+ ?
Tail length/total length	0.66	0.67	—
Head length	55.9	50.0	55.4
Head width	26.1	24.9	26.0
Head depth	23.6	20.0	21.6
Head length/head width	2.14	2.01	2.13
Head length/head depth	2.37	2.50	2.56
Tip of snout to anterior border of nostril (a)	12.6	12.2	12.9
Posterior border of nostril to anterior angle of eye (b)	16.0	13.8	16.6
b/a	1.27	1.15	1.29
Supraoculars (right and left)	3/3	3/3	3/3
Number of scales from rictus to rictus over the head	45	48	44
Number of scales from gular fold to anterior border of hind limbs	88	87	90
Number of scales around body	97	99	95

REMARKS: These three specimens were examined by Burt and Burt (1932, p. 554) and identified as *Varanus kordensis*. They cannot be identified with *kordensis*, which is also a subspecies of *prasinus*, because the latter has smoother and larger head scales, no tuberculated nuchal scales, and a lower number of scales. In addition, *kordensis* is green in color, whereas the new subspecies is as melanistic as *beccarii* from the Aru Islands. It can easily be differentiated from *beccarii* by the characters given in the diagnosis. Doubtless the melanism of the new subspecies and that of *beccarii* is a result of convergence, and both were derived independently from *V. p. prasinus*. *V. p. bogerti* is derived directly from *V. p. prasinus* because both are found in the same archi-

pelago, that is, Goodenough (Dauila), from which Burt and Burt (1932, p. 554) have reported the latter. I have examined this specimen, A.M.N.H. No. 42373, which is a *V. p. prasinus* with somewhat narrower and more strongly keeled nuchal and dorsal scales than is characteristic of the subspecies.

The new race is named in honor of Mr. Charles M. Bogert, Curator of the Department of Amphibians and Reptiles at the American Museum.

Varanus rudicollis Gray

A.M.N.H. No. 69651, juvenile from Kamoukgyi Chaung headwaters, Lower Burma, collected by Arthur S. Vernay in 1928.

A.M.N.H. No. 36235, head of adult from Maliwun, Lower Burma, collected by Arthur S. Vernay on February 28, 1928.

M.C.Z. No. 32264, type of *Varanus scutigerulus* Barbour from Kampong Ulu, Madalam River, Sarawak, Borneo, collected by Harrison W. Smith on February 3, 1915.

The examples from Lower Burma are doubtlessly *V. rudicollis*, the first records for this country. These extend the range considerably to the north, approximately paralleling the range of *V. dumerili*.

The examination of the type specimen of *V. scutigerulus*, a dry skin with skull, revealed that Barbour (1932, p. 1) unfortunately mistook small apertures on the tip of the snout for nostrils, whereas the holes had been made by insects. The true nostrils are large slits near the eye; they were revealed when the area was moistened with water. There is no doubt that this is *V. rudicollis* with which *V. scutigerulus* Barbour should be placed in synonymy, and the notation of *V. salvator scutigerulus* by Mertens (1942, p. 259) should be suppressed.

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A SEMIONOTID FISH FROM THE CHINLE FORMATION, WITH CONSIDERATION OF ITS RELATIONSHIPS

BY BOBB SCHAEFFER AND
DAVID H. DUNKLE¹

INTRODUCTION

In 1879 C. D. Walcott discovered isolated fish scales and teeth at several levels in an exposure of the Chinle formation near Kanab, Utah. Visiting this locality again in 1882, he found more complete fish remains at a horizon about 860 feet above the Shinarump conglomerate which were subsequently submitted to C. R. Eastman, then at Harvard University, for identification. Eastman recognized two forms in this collection, tentatively assigning one to *Pholidophorus* sp. (Eastman, 1905), and the other to a new species of *Lepidotes*, *L. walcotti* (Eastman, 1917). Further preparation of this material fails to confirm the identification of the specimens referred to *Pholidophorus*. The description and taxonomic evaluation of the latter constitute the basis for this paper. Through circumstances now unknown, the specimens of *L. walcotti* and the form herein described were divided between the United States National Museum and the American Museum of Natural History.

Fishes from the fresh-water Upper Triassic formations of western North America continue to be rare and mostly fragmentary in spite of rather intensive prospecting at a number of promising localities. In addition to the specimens mentioned above from the Upper Chinle of Kanab Canyon, Hesse (1935) has described *Semionotus* cf. *gigas* from about the same horizon in

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Zion Canyon and Camp (*in litt.*) reports unidentified fish scales, again at approximately the same level, from a locality south of Moab, Utah. Colbert (personal communication) and others have obtained *Ceratodus* teeth at various localities in the lower Chinle of the Petrified Forest area, Arizona. Branson and Mehl (1931) record the presence of isolated scales and teeth representing "at least three new genera and possibly four or five new species" from the top of the Chugwater formation in Wyoming, and Branson (1948) reports the discovery of a *Ceratodus* tooth from the Popo Agie member of the Chugwater. The Dockum formation in Texas has yielded two species of *Ceratodus*, *C. dorothea* (Case, 1921) and *C. crobsiensis* (Warthin, 1928), and also the quadrate of a coelacanth, very probably wrongly referred to *Macropoma* by Warthin. The coelacanth evidence is of particular interest, as Welles (1947) has figured some skull fragments from the Upper Moenkopi of Arizona that Westoll (letter to Welles) believes may also belong to the Coelacanthini.

In addition to the above occurrences, several specimens of an undetermined fish from the Dockum formation in Union County, New Mexico, are possessed by the Cleveland Museum of Natural History (catalog no. 7259). Unfortunately, the nature of their preservation does not permit conclusive identification. Nevertheless, these latter are indicated to be closely related to the presently described species from the Upper Chinle of Utah.

Brough (1931) is of the opinion that the fish fauna of the Newark series shows evidence of endemism. This conclusion is based on the large number of currently recognized species of *Semionotus* and on the presence of dictyopygids, which had apparently disappeared elsewhere (with the exception of *Dictyopyge* in Europe) by the end of the Middle Triassic. The coelacanths thus far described from this fauna may also support such a thesis (Schaeffer, 1948). In the western United States at least the lower portion of the Chinle was deposited contemporaneously with the Chugwater and the Dockum. In the absence of the physical barriers that may have limited the dispersal of the Newark fauna, it is reasonable to suppose that the fish fauna was well distributed. This is supported by the wide distribution of *Ceratodus*. The occurrence of *Lepidotes* and *Semionotus*, as well as *Ceratodus*, is not unexpected, as these genera are present in Upper Triassic faunas in other parts of the world. The absence of catopterids or other subholosteans as well as palaeoniscoids cannot be confirmed until

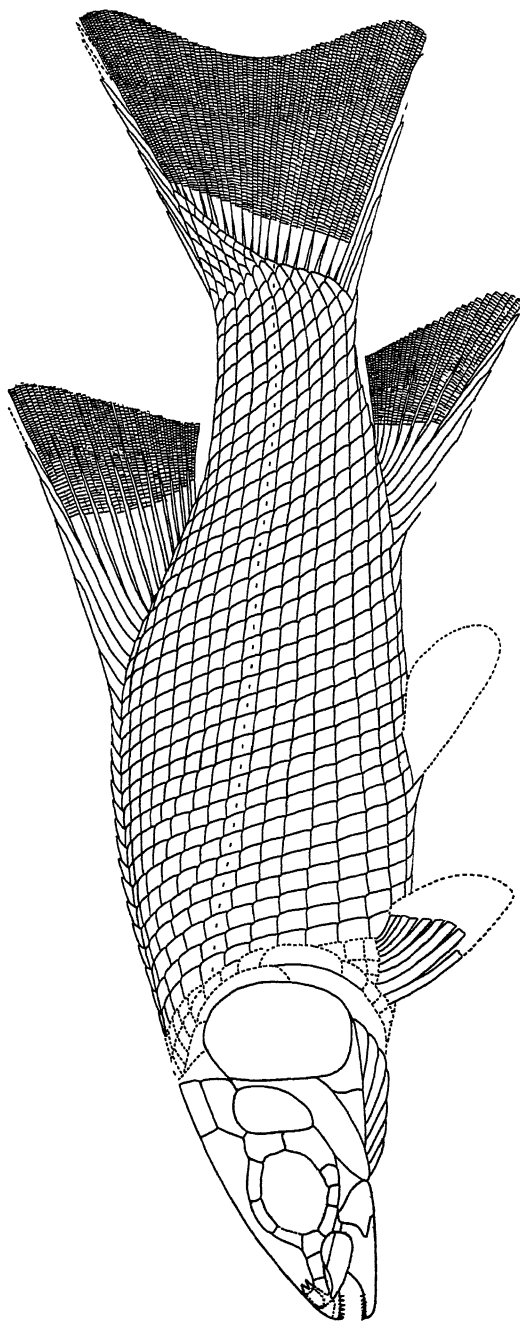


FIG. 1. *Semionotus kanabensis*. Reconstruction. Approx. $\times 2 \frac{1}{3}$.

an attempt is made to identify the various collections of isolated scales. It is of interest that Welles has obtained scales possibly belonging to *Boreosomus* sp. in the Moenkopi.

There is thus fragmentary evidence of a more typical Upper Triassic fish fauna in the Chinle, Chugwater, and Dockum than in the Newark. Whether the paucity of collected material from the West is due entirely to a lack of proper conditions for fish preservation or at least in part to a failure to discover the proper facies is a matter that can be settled only by further exploration.

The drawings for this paper were prepared by Mr. John R. Le Grand and the photographs were taken by Mr. Elwood Logan.

TAXONOMY AND DIAGNOSIS

SEMIONOTIDAE

GENUS SEMIONOTUS AGASSIZ, 1832

GENOTYPE: *Semionotus bergeri* Agassiz.

Semionotus kanabensis, new species

TYPE: A.M.N.H. No. 8870. Complete fish with uncrushed skull.

HORIZON AND LOCALITY: Upper portion of Chinle formation, Upper Triassic, near Kanab, Kane County, Utah, approximately Sec. 27, T. 43 S., R. 6 W. According to Walcott's field notes (published in part by Cross, 1908) the fish occur in a fine-grained, light red sandstone layer about 860 feet above the top of the Shinarump conglomerate. Camp (1930) states that this horizon, which he probably identified in 1923, is about 1 mile east of, and 400 feet above, the Kanab schoolhouse.

SPECIFIC DIAGNOSIS: A small, fusiform semionotid, differing from all other known species of the genus *Semionotus* by the following combination of characters: Body length not exceeding 7.40 cm. in available specimens, head about one-fourth that length, greatest body depth about one-fifth total length. Skull roof pattern essentially as in other species of genus, with a strongly interdigitating suture between nasal and frontal bones. Gape small, lower jaw articulation below middle of orbit. Pre-maxillaries in contact, with posterior process extending between the anterior borders of the frontals; dentigerous portion forming about one-third of jaw margin and bearing about 10 small pointed teeth. Maxillary very short, not reaching anterior border of

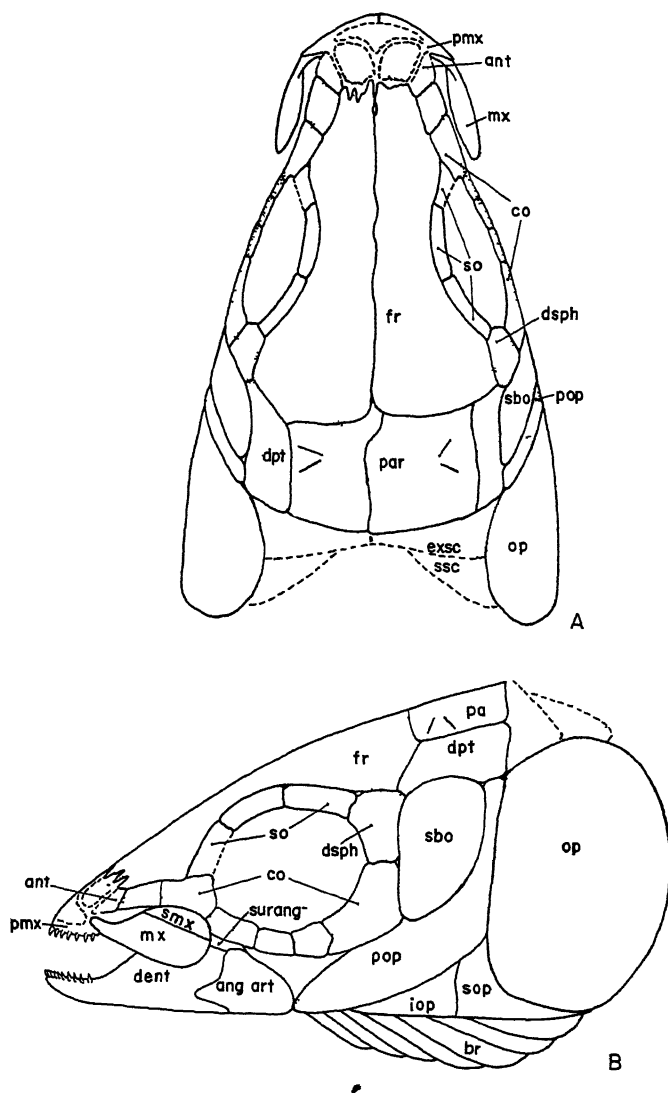


FIG. 2. *Semionotus kanabensis*. Reconstruction of the skull, $\times 5.25$. A. Dorsal view. B. Lateral view. *Abbreviations:* ang art, angulo-articular; ant, antorbital, br, branchiostegal, co, circumorbital, dent, dentary; dpt, dermosphenotic; dsph, dermosphenotic; exsc, extrascapular; fr, frontal; iop, interopercular; mx, maxillary; op, opercular, pa, parietal; pmx, premaxillary, pop, preopercular, sbo, suborbital; smx, supramaxillary, so, supraorbital, sop, subopercular; ssc, suprascapular, surang, surangular.



FIG 3 *Semionotus kanabensis* A A M N H No 8871, dorsoventrally crushed skull, $\times 2$ B A M N H No 8870, anterior half of the type specimen $\times 2$

orbit, expanded and rounded posteriorly, probably edentulous. At least one supramaxillary present. Mandible very narrow at symphysis, rising rapidly to high coronoid process, marginal teeth shaped as in premaxillary and procumbent at symphysis, inner teeth more robust. Circumorbital series complete and extending forward along lateral margin of frontal. Posterior circumorbital enlarged and in contact with anterior process of preopercular. Single large suborbital partially covering ascending process of preopercular. Suspensorium forwardly inclined. Anterior process of preopercular extending to middle of orbit. Opercular relatively large, with straight anterior border. Gular plate apparently absent.

Pectoral fin with eight or more uniserial and biserial fulcra and rays, degree of segmentation unknown. Nature of pelvic fin not determinable, indicated origin midway between origins of pectoral and dorsal. Dorsal fin composed of one short uniserial fulcrum, three robust, biserial basal fulcra, at least one fringing fulcrum, and about 11 rays segmented for half of distal length, origin opposite that of anal. Anal fin with four basal fulcra, three being biserial, followed by two fringing fulcra and about seven segmented rays. Caudal fin moderately forked, hemiheterocercal, scaled caudal lobe extending about halfway along upper border, epichordal and hypochordal lobes of about equal size and bordered by fulcra.

Scales small, thin, rhombic, and smooth; some or all flank scales with serrations on posterior border. Lateral line scales notched on posterior border. Dorsal ridge scales slightly enlarged, attenuated posteriorly.

REFERRED SPECIMENS

A.M.N.H. No. 8871, dorsoventrally crushed and partly dissociated skull and anterior portion of body

U.S.N.M. No. 18399, laterally compressed skull with well-preserved cheek area and mandible, also section of body including dorsal and anal fins

U.S.N.M. No. 18400, patches of scales and broken skull elements

DESCRIPTION

SKULL: The three skulls available for this study lack the median rostral and paired nasals. The rostral, if present, would necessarily have been a small triangular and anteriorly placed element. The frontals are exceedingly narrow anteriorly and exhibit a strongly dentate anterior margin. This condition suggests that

the paired nasals approached each other closely in the median line, although they may not have been in contact, and covered the ascending processes of the premaxillaries. The frontal is about 2.5 times longer than its greatest width and is constricted

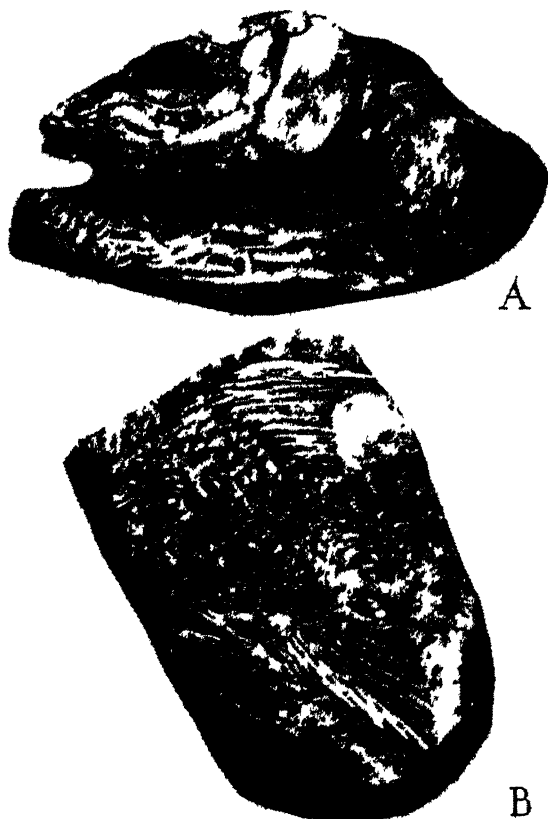


FIG. 4. *Semionotus kanabensis*. U.S.N.M. No. 18399, $\times 2$. A. Skull in lateral aspect. B. Portion of body of same individual showing dorsal and anal fins.

in the orbital region. The supraorbital sensory canal is indicated by a row of relatively large pores close to the lateral borders of this element. Although the parietal area has been crushed and telescoped to some extent, it is evident that the parietals are

almost square and articulate with each other by an undulating suture. The median and posterior pit lines are indicated on the right parietal of the type specimen. The dermopterotic is longer than wide and has the usual contacts with the frontal, dermosphenotic, and parietal. The course of the postorbital sensory canal is represented by large pores. There is no clear indication that the supraorbital and infraorbital canals are united, although the orientation of the supraorbital canal along the lateral border of the frontal and towards the dermopterotic rather than the parietal suggests that such may be the case.¹ Extrascapulars are present but poorly preserved; the suprascapular series is obscured because of crushing.

The premaxillary is well preserved in all three skulls. The tooth-bearing or marginal portion is short and tapers to a point laterally along the articulation with the maxillary. It bears about seven robust, conical and bluntly pointed teeth which are attached along the outer border. The posterior process is wide anteriorly, gradually tapering to a point at the interdigitation with the anterior border of the frontal. The premaxillaries meet throughout their length along a rounded ridge, which may have been exposed dorsally, and lateral to which is a large foramen for the olfactory nerve. In front of this foramen there is a much smaller one, presumably for the terminal branch of palatine VII. As in *Amia* (Allis, 1898), the expanded posterior process must have formed part of the floor of the nasal pit.

The edentulous maxillary is exceedingly short, less than the length of the orbit. It has an extensive curved articulation with the marginal portion of the premaxillary and from this articulation widens rapidly posteriorly, with the greatest depth equaling about two-thirds of the length. The posterior border is gently rounded and shows no indication of notching. The most striking feature of the maxillary is the presence of a robust, medially directed process that extends between the marginal portion of the premaxillary and the autopalatine and terminates under the ascending process of the premaxillary. This is exactly comparable to the situation in other species of *Semionotus*, *Lepidotes*,

¹ The fusion of these canals, considered to be a character of the Semionotidae by Brough (1936), may not be a constant feature in this family, at either the generic or specific level. Fusion is evident in *Semionotus nilssoni* and *S. capensis* but not in *S. brauni*. It occurs in the specimen of *Lepidotes semiserratus* figured by Westoll (1937) but not in a specimen of the same species figured by Rayner (1948).

Sinamia, and *Amia*. The rod-like median process, in *Amia*, terminates in a shallow socket on the under side of the premaxillary, and it may do the same in the Kanab form, although this cannot be definitely determined. There is a single narrow supramaxillary.

The circumorbital series completely encircles the orbit and extends onto the snout in typical semionotoid fashion. In U.S.N.M. No. 18399 the posterior and ventral borders of the orbit are framed by five elements, including the dermosphenotic. At least two elements, indicated in the type specimen, frame the dorsal orbital rim between the dermosphenotic and the snout series. There are three elements in front of the orbit that articulate above with the frontal and presumably the nasal. In the absence of the rostral and nasal bones, and the lack of evidence for identifying the antorbital bones, it is not possible to determine the exact position of the anterior and posterior nares.

The single oval suborbital is of about the same relative size and shape as the single member of the suborbital series in *Semionotus nilssoni*. It appears to cover most or all of the ascending process of the preopercular. This feature, which is thus almost unique among semionotids, is associated with another one previously unknown in this family. The posterior circumorbital, lying immediately ventral to the dermosphenotic, is somewhat enlarged and in contact with the anterior ramus of the preopercular. These characters were perhaps responsible for Eastman's identification of these specimens as pholodophorid.

The preopercular is a crescent-shaped element with ascending and anterior processes of about equal length. The ascending process is narrow and rod-like, expanding ventrally into the anterior portion. The pores of the preopercular canal are prominent, and primary tubular extensions are evident on the anterior arm. The opercular is essentially oval, with a straight anterior border. As are the other dermal elements of the skull, it is smooth and unornamented. The subopercular has a rounded ventral margin, and its exposed area is about one-third or less of the opercular height. The interopercular is triangular and is covered in part by the preopercular.

The mandible is very low in the symphyseal region, with a straight inferior margin. Orally it rises rapidly to form a high coronoid process. There are about 10 slender, conical, pointed,

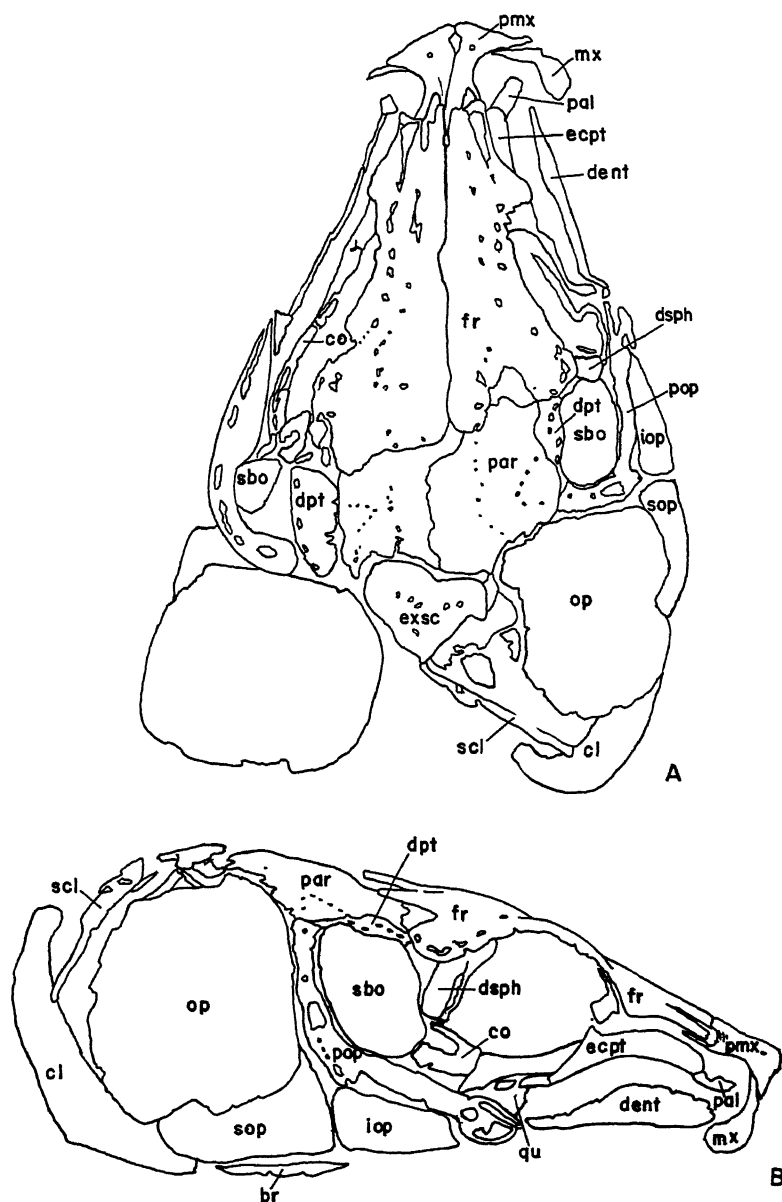


FIG. 5. *Semionotus kanabensis*. Skull of the type specimen, A.M.N.H. No. 8870, $\times 5 \frac{1}{3}$. A. Dorsal view. B. Lateral view. Additional abbreviations: cl, cleithrum; scl, supracleithrum.

and somewhat procumbent marginal teeth on either side of the symphysis. An inner row of stouter teeth is also present, but their form cannot be determined. The angulo-articular is almost rectangular in shape, with a vertical posterior border, and is clearly separated from the dentary by an undulating suture. The surangular may also be distinguished, extending anteriorly beyond the suture between the dentary and the angulo-articular. The mandibular canal is very prominent, running close to the ventral border of the angulo-articular and the dentary. A gular plate is not indicated in any of the specimens, and it may have been absent as in *Lepidotes* (Woodward, 1895; Saint-Seine, 1949).

Elements of the hyoid arch and the palate are present in all three skulls but are obscured or poorly preserved. An impression of the hyomandibular in U.S.N.M. No. 18399 is in essentially a vertical position and is about three times longer than the width at the neurocranial articulation. The opercular process is small, although its exact shape cannot be determined. The symplectic is long and rod-like, with a proximal expansion where it connects with the hyomandibular. The epihyal cannot be observed. The ceratohyal consists of a single ossification, expanded proximally and distally, and lacking a fenestra. There is no indication of a groove for the hyoid artery. Two poorly defined ossifications in front of the ceratohyal represent the hypohyal and possibly the glossohyal. The branchiostegals number at least seven and are broad and plate-like, with no proximal constriction.

The quadrate is a relatively small triangular element, thickened and apparently rounded at the mandibular articulation and bearing posteriorly a splint-like process which abuts against the distal end of the symplectic. No evidence of the metapterygoid has been observed. The ectopterygoid is curved and narrow. It has a wide groove along the anterior half of the dorsal or mesial border, and the posterior wall of the groove expands into a medially directed process at its anterior end. This process supports in part the autopalatine and probably also the entopterygoid at their point of articulation. Seen in poorly defined impression in U.S.N.M. No. 18399, the entopterygoid is of the normal, broad triangular outline. The dermopalatine is a separate ossification and, as does the ectopterygoid, appears to lack teeth. The autopalatine has a broad articulation with the entopterygoid and

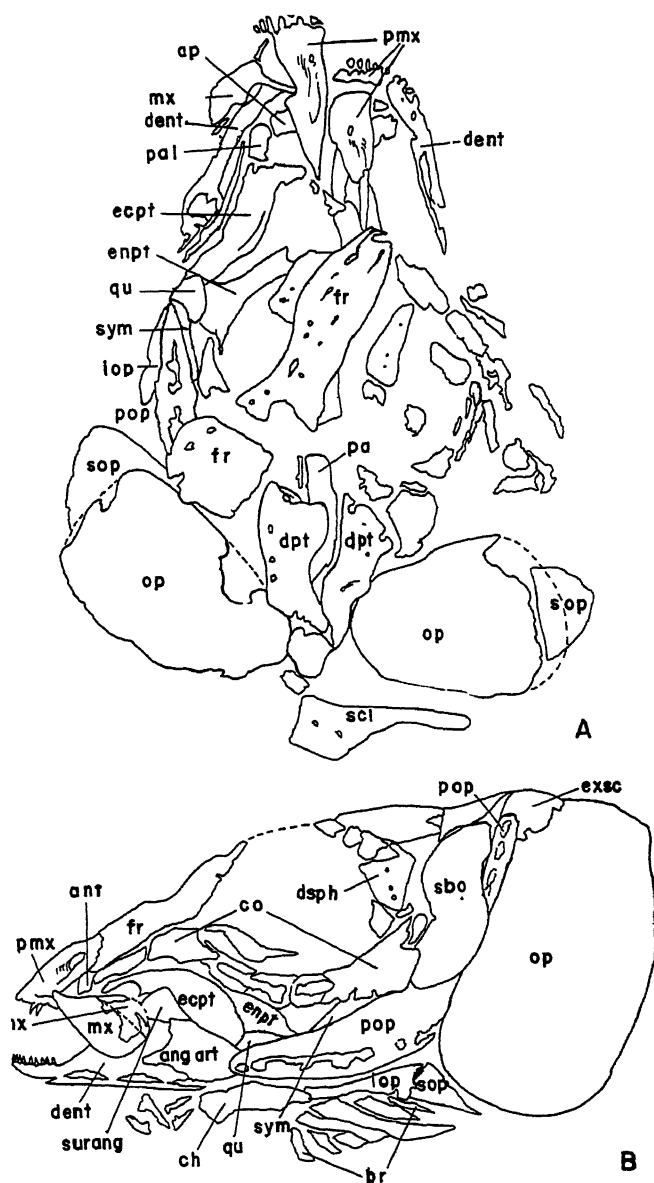


FIG. 6. *Semionotus kanabensis*. A. Details of dissociated skull, A.M.N.H. No. 8871, $\times 4.5$. B. Details of U.S.N.M. No. 18399, $\times 4.5$. Additional abbreviations: ap, autopalatine; ch, ceratohyal; ecpt, ectopterygoid; enpt, entopterygoid; pal, dermopalatine; qu, quadrate; sym, symplectic.

occupies the area between that bone and the median process of the maxillary as in *Amia*.

A few neurocranial structures can be observed, but unfortunately adequate comparison with Rayner's work (1948) is not possible. As partially exposed in U.S.N.M. No. 18399, the parasphenoid is a narrow but relatively robust element, with distinct lateral grooves accommodating the palatine branches of the facial nerve. It overlaps dorsally, opposite the anterior border of the orbit, the posterior extremity of the vomer which is undoubtedly paired.

POSTCRANIAL SKELETON: The shoulder girdle as exposed on the right side of the type specimen exhibits only the cleithrum in the normal position. An element that may be the supracleithrum is turned on edge in front of the upper part of the cleithrum, but its position prevents preparation. Fragments representing one or more postcleithral ossifications are present, one attached to the cleithrum at the base of the pectoral fin. The exposed portion of the cleithrum is narrow and curved only in its dorsal portion. The expanded ventral part is completely covered by the operculum. The pectoral fin is composed of an unknown number of uniserial and biserial fulcra plus rays that are not clearly segmented and are therefore difficult to distinguish from the fulcra. At least eight fulcra and rays are evident in the type specimen.

The pelvic fins are not preserved in any of the specimens. Their position is indicated in the type by several incomplete rays that appear to be undisturbed and place the origin about midway between the origins of the pectoral and dorsal.

The triangular dorsal fin arises somewhat anteriorly to the origin of the anal. It is made up of one short, uniserial, fulcral scale followed by three basal, biserial fulcra of increasing length, and at least one fringing fulcrum and about 11 rays, segmented and dichotomized for half their length. The anal fin is of similar shape, consisting of about four basal fulcra, at least three of which are biserial, two fringing fulcra, and seven rays, divided and segmented in the distal half.

The caudal fin is completely preserved in the type, but is twisted in such a fashion that several important details are obscured. The scale pattern on the caudal axis cannot be exactly determined, but it is evident that the axis extends about half the distance to the tip of the epichordal lobe. The tail is moderately forked. The fulcra bordering both lobes of the tail are thin and

attenuated. Those along the hypochordal lobe are biserial, the ones bordering the epichordal probably so.

SQUAMATION: The scales are smooth and rhombic. They are somewhat enlarged in the flank area but otherwise show no appreciable variation in size except in the caudal extension, where they are smaller. An occasional isolated scale will show an anterodorsal extension, demonstrating the presence of a peg-and-socket articulation. A number of flank scales show about four fine serrations on the posterior edge. Some lateral line scales have a very low, median, superficial ridge, but usually the scale surface is quite smooth, and the only evidence of the sensory canal is a slight notching of the posterior border of the scale. The dorsal and ventral ridge scales are essentially ovate and acuminate. Histologically, the scales are composed internally of a relatively thick, bony, foot plate containing sparse, simple canals and externally of a thinner, entire enamel cap.

DISCUSSION

HOLOSTEAN ORIGINS

Within the last two decades information on the origin and structural relationships of the various holostean orders has been greatly amplified. This has led to the important conclusion that the Holostei do not constitute a natural group, but rather that the included orders were independently derived from different sub-holostean or palaeoniscoid stocks. The diverse evolutionary trends involved in attaining the holostean level, and within the level itself, have been considered by a number of authors. The general phylogenetic picture, however, is still incomplete, owing partly to a lack of transitional stages and partly to the difficulties involved in the interpretation and evaluation of the existing evidence. The apparently unusual combination of characters occurring in *S. kanabensis* presents such an interpretative problem, and a brief review of opinions on the origin of, and observed evolutionary trends in, certain of the holostean orders appears desirable in order to determine its taxonomic position.

For obvious reasons, in the present state of knowledge, Romer (1945) has retained the category Holostei as a superorder. It is composed of the following five orders, apparently natural monophyletic units: the Semionotoidea, Aspidorhynchoidea, Amioidea, Pholidophoroidea, and, with reservations, the Pycnodontoidea.

The second and the last may be eliminated from consideration here, as they represent highly specialized trends clearly not related.

The origins of the remaining three orders have been the subject of much discussion. Prior to the description of the Lower Triassic Parasemionotidae (Ospiidae) by Stensiö (1932) and Piveteau (1934) and the recognition of the Subholostei by Brough (1936), these orders were considered to have a single monophyletic origin from some unknown palaeoniscoid stock (see Brough, 1939, p. 3).

Stensiö (1932, p. 296) was the first to suggest that the Holostei are really a polyphyletic group. He notes the approach of the pholidopleurids to the pholidophoroids in the structure of the vertebral column and scales, the perleidids to the amioids in scale structure, and of the entire ospiid skeleton to the semionotids and amioids. The resemblance of *Ospia* and *Broughia* to the semionotids includes the absence of a postrostral, form of the nasals, freeing of the maxillary, structure of the mandible, nature of the median fins, and finally the scales. He concludes that the "ospiids" may be transitional between the perleidids and the semionotids. Stensiö (*ibid.*, pp. 275-276) makes the interesting suggestion that there is a functional correlation between the freeing of the maxillary and the modification of the dermal bones in the snout area.

Piveteau (1934) considers the parasemionotids to be intermediate between the Chondrostei and the Holostei, with definite advances towards the latter. He states, however, that this family cannot be considered as being directly ancestral to the Holostei because the definitive semionotid *Acentrophorus* was already present in the Upper Permian.

Brough, in 1936, developed the subholostean concept, pointing out that certain families formerly relegated to the Palaeoniscoidea had independently developed various advances towards the holostean level. He believes that while the Dictyopygidae (Catopteridae), Perleididae, and particularly the Parasemionotidae show such changes, there is no evidence that any of them gave rise directly to the Semionotidae, the age of *Acentrophorus* again being a stumbling block.

In 1939 Brough again considered the origin of certain of the holostean orders. He describes the many points of resemblance between certain of the parasemionotids and the caturids (eugna-

thids), such as the presence of large paired nasals, the similar shape of the frontals bordered by a row of supraorbitals, the small parietals with a similar relationship to the large dermopterotics, the resemblances of the extrascapulars, suprascapulars, and the dermosphenotic and the presence of an interoperculum almost anterior to the suboperculum (*Watsonulus*), the close duplication of jaw structure, and the disposition of the first branchiostegal ray. The absence of a suborbital series in the described specimens of the Parasemionotidae is considered at variance with the condition in an eugnathid ancestor. Brough states, however, that this region is figured only in type "A" of *Watsonulus*. It should be pointed out that Piveteau (1934) also indicates the absence of suborbitals in *Parasemionotus* and that the specimens of *Watsonulus* and *Parasemionotus* in the American Museum show no evidence of these elements. They are unknown in *Ospia* and *Broughia*.

As a result of this comparison Brough is of the opinion that the Parasemionotidae may be considered as ancestral to the Eugnathidae, hence the entire Amioidea. He states that such semionotid specializations as the forwardly directed suspensorium, narrow preopercular with anterior arm, reduced and forwardly situated jaws, unique styliform teeth, and narrow parasphenoid, all present in *Acetrophorus*, indicate that the eugnathids cannot be descended from the semionotids. Thus he believes that the eugnathids and semionotids may have had a common palaeoniscoid ancestor, and, by inference, that the parasemionotids are excluded from the ancestry of the semionotids.

Rayner (1941) considers the origin of the holostean orders an open question, but does admit the significance of the resemblance between the dermal skulls of the Parasemionotidae and the Eugnathidae. She points out that no known subholostean or palaeoniscoid family clearly foreshadows the structure of the semionotids or the pholodophoroids.

Westoll (1944) states that the Parasemionotidae and Semionotidae are different in the known structure of the snout area (this is here presumed to mean the dermal bones), the cheek region, and the nature of the transition from the ancestral heterocercal tail to the more hemiheterocercal type. In contrast to other opinions, he believes that good evidence (unpublished) is available for deriving the semionotids from the palaeoniscoid *Elonichthyidae*.

Rayner (1948), on the basis of her study of Jurassic holosteans,

concludes that information on the holostean neurocranium is yet too meager to permit any basic conclusions regarding phylogenetic relationships in this group. On the basis of all available evidence, she considers the parasemionotid-eugnathid transition as the only well-defined link between the Subholostei and the Holostei, and further recognizes some similarities between the semionotids and the less-specialized eugnathids.

The evidence now available indicates that the parasemionotids are the only fishes at the subholostean level advanced enough to give rise to the eugnathids. The semionotoids, when they first appear in the Upper Permian, already possess their definitive ordinal characters and could hardly have arisen from the Lower Triassic parasemionotids. The characteristic semionotid jaw structure and related changes in the cheek are not clearly foreshadowed in any chondrosteian group. From the standpoint of morphological change alone, however, it would appear less radical to derive a semionotid from the parasemionotid type than from any other known palaeoniscoid or subholostean.

In regard to Westoll's statement (1944) concerning the difference between the parasemionotid and semionotid snouts, the present writers are of the opinion that Gill's description (1923) of the snout area of *Acentrophorus* presents the only recorded deviation from the parasemionotid snout pattern among the semionotids. Gill figures four elements across the snout between the "adnasals," two on each side of the midline, but this arrangement is not clearly discussed in the text. In his paper Gill labels the median elements as nasals and states that they are usually crushed against the posterior processes of the premaxillaries. Gregory (1933), however, considers the lateral ones nasals and the median bones to be possibly postrostrals. As *Acentrophorus* is strikingly similar to *Semionotus* and *Lepidotes*, particularly in jaw and cheek structure, it is difficult to believe that either of these descriptions represents the true situation in this genus. As far as can be determined from available material, the nasals of *Semionotus* approach each other in the midline, preceded by a single rostral element. This is also the case in *Lepidotes* (Piveteau, 1934; Rayner, 1948) and *Dapedius* (Woodward, 1895, and specimen). So far as known, therefore, the semionotid snout has a dermal bone pattern like that of the parasemionotids.

The circumorbital series in the parasemionotids is complete and consists (in *Watsonulus*) of eight elements of varying size.

It could, with minor modification, give rise to either the semionotid or the eugnathid type. In similar vein, while it is possible that the palaeoniscoid-subholostean first branchiostegal ray was modified into a true interopercular bone more than once, it is just as plausible to assume that parasemionotids possessing an interopercular existed early enough in the Permian to give rise to the semionotids.

The absence of a clearly distinguishable suborbital series in the parasemionotids might well be regarded as a factor removing them from holostean ancestry. This particular problem and the origin of the holostean suborbitals in general have been considered by several authors. Watson (1925, p. 868) suggests that the bone lying along the anterior border of the preopercular in the palaeoniscoid *Coccocephalus* may represent the possible source of the "postorbital plates" in the lepidosteoids. In 1928, (p. 58) he points out that the three bones between the posterior circumorbitals and the anterior border of the preopercular in *Elonichthys caudalis* represent the single bone in *Coccocephalus*. These bones, Watson states, are the source for the holostean postorbitals (suborbitals).

Aldinger (1937, pp. 364–365) is of the opinion that the holostean suborbitals arose through disintegration of the anterior expanded portion of the palaeoniscoid-subholostean preopercular and that this process may have occurred independently in different groups below the holostean level. This concept is suggested by the apparent transfer of horizontal and vertical pit lines on the preopercular of *Watsonia* and *Parasemionotus* to the suborbitals of certain holosteans, and also by the presence of three small bones arranged in an anteroposterior series in an excavation on the dorsal border of the *Parasemionotus* preopercular, as well as by the occurrence of a small ossification at the lower end of the *Ospia* preopercular. Aldinger believes that this disintegration was associated with the development of a preopercular-palatoquadrate attachment and with the inclusion of the anterior rim of the preopercular in the origin of the adductor mandibulae muscle. With these changes in the architecture of the cheek, he believes that the expanded anterior portion of the preopercular present in many palaeoniscoids and subholosteans would interfere with the action of the adductor mandibulae, and reduction of this portion would occur. The principal objection to this theory is the presence of suborbitals in forms with the anterior expansion (*Palaeomis-*

cus) as well as in those with a vertical suspensorium (*Canobius*).

Stensiö (1947, p. 148) is of the opinion that the suborbitals of the palaeoniscoids and subholosteans have arisen either from anamestic components of the postorbital infraorbitals or from the anamestic anterior portion of the preopercular or from both sources. They are accordingly not considered to be equivalent in the various forms possessing them. Furthermore, he believes the suborbitals may fuse with the suprapreoperculum, as in *Helichthys elegans*, or include bone rudiments formed along the anterior division of the supramaxillary line (defined below) as in *Canobius ramsayi*.

In regard to the origin of the holostean suborbital series, Stensiö (*ibid.*, pp. 153 ff.) proposes two different hypotheses which are briefly and perhaps inadequately summarized as follows: The first is similar to Aldinger's thesis and is also based on the interpretation of the ossifications on the dorsal border of the *Parasemionotus* opercular. These elements, called supraspiraculars by Piveteau (1934), are considered by Stensiö to be suborbitals derived from "the anamestic component of the preopercular." The incorporation of additional preopercular rudiments more ventrally or, as he states it, further subdivision of the anterior border of the preopercular would result in a typical holostean suborbital series. The ventral suborbitals would thus include the vertical and horizontal pit lines formerly situated on the preopercular. (In the *Amia* embryos figured by Allis, 1889, Stensiö interprets the horizontal pit line of the cheek as the middle and anterior divisions of the supramaxillary line in larval urodeles, anurans, and dipnoans and the vertical pit line of the cheek as a postmaxillary line.)

The second hypothesis involves a direct inheritance of the suborbital elements present in many palaeoniscoids and subholosteans, as postulated previously by Watson. The form of the suborbitals in *Ptycholepis curta*, as interpreted by Stensiö, suggests that the holostean pattern was obtained by a moderate posterior expansion of these elements, accompanied by a reduction of the preoperculum to the holostean type. As that portion of the preoperculum carrying the horizontal and vertical pit lines was eliminated, these pit lines became secondarily associated with the ventral suborbitals.

The primary origin of the suborbital series, according to Stensiö's interpretation, requires a subdivision (or possibly a regroup-

ing of rudiments) of the posterior circumorbitals or the anterior border of the preopercular. Certain fusions are also considered likely, for instance, a union of anamestic and sensory line components to form the semionotid ventral suborbitals and a combination of a posterior circumorbital and suborbital to form the enlarged posterior circumorbital of pholidophoroids. In the present writers' opinion the available evidence, experimental, embryological, and morphological, is not conclusive enough to permit such a detailed analysis of evolutionary change in the cheek pattern. The paleontological data alone, however, would appear to favor his second hypothesis for the origin of the holostean suborbitals.

Since the suborbitals are anamestic elements, their number, size, and shape could presumably be readily affected by alterations in the inclination of the suspensorium, the length of the jaws, enlargement of the posterior circumorbitals, and other changes concerned with cheek design. Westoll (1937) has discussed the secondary association of the vertical and horizontal pit lines with the enlarged posterior circumorbitals in *Amia*, and this is probably also the situation in the suborbital mosaic of *Lepisosteus*.

In the last analysis, a really airtight case for the important phylogenetic position assigned to the parasemionotids requires further elucidation of the suborbital problem, particularly since these elements are present in most palaeoniscoids and other subholosteans. Perhaps the situation in *Perleidus* is of some significance in this connection. *P. madagascariensis* (Piveteau, 1934) and *P. stochiensis* (Stensiö, 1932) apparently lack suborbitals, while Stensiö (1921) is of the opinion that several are present in *P. woodwardi*. The cheek area of *Pholidophorus* is also of interest. *P. bechei* (Rayner, 1948) has three posterior circumorbitals, with one meeting the preopercular below a single suborbital; *P. similis* (Saint-Seine, 1949) has two enlarged posterior circumorbitals, the lower one meeting the preopercular but not extending along the ventral border of the suborbital; *P. segusianus* (Saint-Seine, 1949) has a single greatly expanded posterior circumorbital but no suborbital. If such variation can occur at the interspecific level, the presence of these elements in some unknown parasemionotid or in a parasemionotid descendant appears more reasonable. Conversely, the loss of all but one suborbital in *Semionotus kanabensis* and *S. nilssoni* also seems plausible.

HOLOSTEAN RELATIONSHIPS

The character complexes of the dermal skull separating the Semionotoidea, Amioidea, and Pholidophoroidea have been analyzed at some length by Brough, Rayner, Saint-Seine, Stensiö, and Westoll. In the brief review below of certain of the differences and resemblances in skull pattern, some additional points may be mentioned that possibly have a bearing on the interrelationship of these orders.

The arrangement of the semionotoid skull roof, with the exceptions noted below, is almost identical with that of the other two orders, including the usual presence of a median rostral that may or may not separate the paired nasals. The semionotoid premaxillary has a strong ascending process that usually extends to or under the frontal. The maxillary is expanded and rounded or blunt posteriorly and does not extend beyond the middle of the orbit. It has an anterior median process that fits between the marginal portion of the premaxillary and the palatine elements. A single supramaxillary is present in *Semionotus* and *Lepidotes*. The circumorbital series is complete and is usually composed of 10 to 12 almost square elements, although neither the number nor the shape is constant. The infraorbitals extend forward to the snout, in series with the antorbital and the nasal. The number of elements in the suborbital series is probably subject to considerable intraspecific and interspecific variation, evident in both *Semionotus* and *Lepidotes*, with most genera having one to six bones, except *Lepisosteus* where the number is greatly increased. The preopercular is narrow and crescent shaped; the anterior arm may meet the vertical one at a distinct but wide angle and almost equal it in length. The size of the opercular in relation to the subopercular is also variable, small in *Acentrophorus* and *Lepidotes*, large in at least some species of *Semionotus*. The dentigerous portion of the mandible is short (except in *Lepisosteus*), with the dorsal border rising rapidly but not abruptly to a high coronoid process.

The semionotoids are known from the Upper Permian to the Recent. During this period, according to available evidence, there have been several evolutionary trends away from the basic design of the order as typified by *Acentrophorus* and *Semionotus*. One culminated in the deepened skull and hypsisomatic body form of *Dapedius* and *Tetragonolepis*, the other in the long-skulled,

long-bodied *Lepisosteus*. The hypsisomatic trend also occurred in the palaeoniscoids and the subholosteans, and the lepidosteoid trend in the subholostean and another holostean group; both developed a number of times in the teleosts.

The amioid skull roof exhibits significant modification only in the more specialized macrosemiids which have apparently lost the median rostral and have the elongated ethmoid exposed between the frontals and the reduced nasals. The amioid premaxillary has a robust posterior process, definitely known in *Heterolepidotus*, *Caturus*, *Oeonoscopus*, *Sinamia*, *Amia*, and *Ophiopsis*. The maxillary is long, except in the advanced macrosemiids, usually extending to the posterior border of the orbit. The posterior border is often notched, although in *Macrosemius*, *Disticholepis*, and *Notagodus* it is rounded as in the semionotids. An anterior median process has been described in several genera which bears the same relationship to the premaxillary and palatines as in the semionotids. The infraorbitals are relatively larger and not so numerous as in the semionotoids, again excepting the advanced macrosemiids where they are greatly reduced. The supraorbitals are variable; they resemble, for instance, the semionotid type in *Eoeugnathus*, are irregular, small, and greatly multiplied in *Caturus*; they are present in *Sinamia* but are absent in *Amia*. As in the semionotids, the suborbitals show great variation in size, shape, and number, and may be absent entirely as in *Amia*. The preopercular is crescent shaped and narrow. The anterior extension of the preopercular characteristic of the semionotoids is missing, except where the gape has been secondarily reduced as in *Notagodus*.

In spite of statements to the effect that the eugnathids and amiids have a characteristic opercular pattern (Brough, 1939, p. 84), it is possible to observe considerable variation in the relative size and shape of the opercular, subopercular, and to a lesser extent the interopercular. It appears practically impossible to define the amioid opercular complex in such a way as to exclude the semionotids and, for that matter, either the pholidophoroids or the archaeomenids. The mandible, as Rayner points out, has a characteristic form in most eugnathids and amiids that is not entirely shared by the macrosemiids.

The eugnathid-amiid group has had a remarkably conservative history. The few discernible trends, all more or less minor, have been discussed by Brough (1939), Rayner (1941), and Saint-Seine

(1949). From the eugnathid stock a trend towards a long-snouted, istiophorid-like habitus developed in the pachychormids, culminating in *Protosphyraena*. The skull of *Pachycormus* (Lehman, 1949) shows unmistakable eugnathid resemblances in spite of certain obvious specializations. Among the macrosemiids, Saint-Seine (1949, p. 287) has described the apparently progressive change in the series *Ophiopsis-Macrosemius-Notagogus-Propterus*, consisting of elongation and exposure of the ethmoid region, relative reduction of the frontals, forward migration of the suspensorium with accompanying modifications in jaw structure, reduction of the ventral circumorbitals, and loss of the suborbitals. The jaw structure of the more specialized macrosemiids, particularly *Disticholepis*, is very suggestive of that found in the semionotids. The great difference in the structure of the cheek area in these two groups indicates, therefore, the range of modification that may be expected in this area in holosteans with a forwardly directed suspensorium.

Saint-Seine (1949) has revived the category Halecostomi to include the pholidophorids, leptolepids, oligopleurids, pleuropholids (*Pleuropholis* only), and also the aspidorhynchids and protelopids (*Eoprotelops* only). These families are considered to be "progressive" among the holosteans in that they share certain teleost characters such as a habitual absence of the basipterygoid process, a mandible composed only of dentary and angulo-articular, the usual absence of a gular, a mobile premaxillary, an ossified but covered supraoccipital, and a consistent disappearance of the suborbital series. With the exception of the inclusion of the aspidorhynchids and the new genus *Eoprotelops* (placed in the new family Protelopidae and the new Order Elopoidea), the Halecostomi agree in their range with the Pholidophoroidea of Romer's classification. The pholidophorid-leptolepid-*Eoprotelops* group clearly foreshadows the teleosts and more specifically the Elopidae and, as Saint-Seine points out, the leptolepids may be ancestral to the chirocentrids. The oligopleurids and *Pleuropholis* represent specialized and isolated types with obscure antecedents; they may have evolved from some amioid stocks. Although the aspidorhynchids share a number of characters in common with the other halecostomids, they are, as Saint-Seine states, highly specialized at their first known appearance.

The skull roof of the conservative pholidophoroids conforms to the semionotid-amioid pattern, more strikingly so in the archaeo-

maenids than in the pholidophorids. The premaxillary is generally small, lacks a posterior process, and may have been partly mobile. The maxillary has a median process, evident in *Pholidophorus* and *Aphnelepis*, which probably has the customary relationship with the premaxillary and palatines. The archaeomaenids, closely related to the pholidophorids, show a tendency towards a small gape, shortened maxillary, and reduced suborbital series. The convergence towards the semionotid skull is remarkably close.

The impossibility of postulating, at the present time, a common ancestral stock for the variety of distinct evolutionary trends included in the Halecostomi suggests that the characters shared in common may actually have evolved independently and that the Halecostomi represent a structural grade rather than a natural taxonomic unit. As various subholostean groups separately approached the holostean level, so it seems entirely reasonable, in fact probable, that different holostean lines separately evolved teleostean characters. It still has not been demonstrated, however, that the Teleostei had a polyphyletic origin; their ancestry is as yet restricted to the pholidophorids. The inclusion of the leptolepids and *Eoprotelops* in either the Pholidophoroidea or the Teleostei represents a taxonomic problem similar to that regarding the position of *Seymouria*; the more complete the evidence the more arbitrary are the systematic boundaries.

In summary, the semionotoids, amioids, and pholidophoroids (as used in Romer's classification) have essentially the same skull roof pattern. The first two have a similarly constructed premaxillary, while all three have a median process on the maxillary. Whether these resemblances are simply parallelisms or are indicative of common ancestry cannot be determined at the present time. This evidence does suggest, however, that semionotoids and amioids had a common ancestral stock in the Permian, with the former developing its short-jawed specialization by the Upper Permian. The pholidophoroids may well have evolved from the same stock, possibly the parasemionotids, at a later time. The modifications in *S. kanabensis* further indicate the intimate relationship that must exist between the form of the jaws, the direction of the suspensorium, and the pattern of the cheek area and suggest that the suborbital series is particularly sensitive to any changes in this relationship.

The taxonomic position of *S. kanabensis* may now be considered in the light of this discussion. On the basis of the skull roof pat-

tern, it could be assigned to each of the three orders just considered, while the structure of the premaxillary would permit allocation to either the semionotids or the amioids. The maxillary and the mandible are, however, typically semionotid and are quite distinct from the paralleling archaeomaenid type. The slender, conical, marginal dentition, the more robust inner teeth, and their arrangement further indicate semionotid affinity. The arrangement of the circumorbital series is likewise semionotid, with the exception of the enlarged posterior member which meets the anterior border of the preopercular. The suborbital series, being reduced to one element, agrees in this respect with *S. nilssoni*, a condition formerly reported only for the pholidophoroid-leptolepid line. The opercular complex of *S. kanabensis*, particularly in the relative size and shape of the opercular bone and the form of the preopercular, resembles rather closely that of other species of *Semionotus*. The squamation, fins, and general body form further support allocation to the Semionotidae.

Rayner (1941) has pointed out that the stability of the skull roof, the palate, and even fin structure at the holostean level reduces the importance of these character complexes in classification. Jaw structure appears to be one of the most reliable diagnostic criteria at the ordinal and, in some cases, at the familial level. Since adaptive modification in jaw form is reflected in the cheek area, this region is also of value. The cheek area of *S. kanabensis* and *S. nilssoni* indicates, however, that the design of this region may vary considerably within a family having a more or less uniform jaw structure. While such variation appears to be exceptional, it can and does occur.

The assignment of *S. kanabensis* to the Semionotidae requires a greater adaptive variation in the cheek area than has been suspected for this family. The desirability of placing *S. kanabensis* in a new family has been considered. Of the 13 genera currently placed in the Semionotidae, however, the cheek pattern is sufficiently known only in *Acentrophorus*, *Semionotus*, *Lepidotes*, and *Dapedius*. There is thus but little evidence for determining the possible range of cheek modification or for believing that all genera assigned to this family must have a cheek pattern essentially like that of *Acentrophorus*. At the present time, therefore, a more conservative designation is considered desirable.

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FOUR NEW SUBSPECIES OF THE GENUS *CICINDELA* (COLEOPTERA, CICINDELIDAE)

BY PATRICIA VAURIE

The large amount of cicindelid material at the American Museum of Natural History, much of it of recent collection, has revealed many geographical subspecies not before recognized. The description of a few of these at this time was undertaken at the suggestion of Dr. Mont A. Cazier in order to facilitate his monograph on the Cicindelidae of the United States, now in progress.

Cicindela californica viridicyanea, new subspecies

Labrum with front margin feebly tridentate, the median tooth more prominent and acute; antennal scape with a single long white hair at apex only; gena without hair; front of head without hair; thorax with a few scattered, white, reclining hairs on sides, base, and apex; elytra, male, nearly parallel to apical fifth, then narrowing obliquely to the conjointly rounded, but somewhat truncate apex, each elytron with small acute spine at suture; female same as male except apices of elytra separately rounded, the sutural angle retracted, the spine less acute. Elytral markings connected along margins, basal lunule scarcely defined, middle band well defined, short, narrow, oblique, stopping before reaching the suture, with its apex sometimes rounded, sometimes truncate. Color above and below bright green or blue.

TYPE LOCALITY: Wilcox, [Cochise County], Arizona, holotype male, Wilcox, Arizona, September 1, 1947 (F. H. Parker), allotype female, Wilcox, Arizona, August 18, 1949 (F. H. Parker), and 52 paratopotypes. Holotype and allotype and 34 para-

topotypes in the American Museum of Natural History; other paratopotypes in the collections of F. H. Parker and C. de W. Funaro.

DISTRIBUTION: Wilcox, Arizona.

Differs from the other subspecies in the bright green metallic color above and in the lack of coppery or red reflections on the sides of the thorax below. Differs further from *praetextata* (Arizona, New Mexico, Texas) by having the middle band of the elytra shorter and less oblique, or narrower; from *mojavi* (southern California) in that the markings are separated, not confluent; from *californica* (Lower California) in that the markings are connected along the margins.

DISCUSSION: The elytra in 14 of the 54 specimens is bright blue, almost purple, in 29 it is bright green, in nine a duller, darker green, and in two it lacks the metallic reflections and is more or less brown, as in *mojavi*, but these two have the thorax below characteristically green. The thorax above is usually the same color as the elytra, sometimes a different shade.

This subspecies is quite isolated from its nearest neighbors (allopatric), and no intermediates have been seen.

Some of the specimens (Parker) were collected "on the sand banks of a pond" in the Sulphur Spring Valley area near Wilcox at 4156 feet. There is probably alkali here, as Parker mentions patches of a "coarse, wiry alkali-tolerant grass" that grows on the banks.

***Cicindela scutellaris flavoviridis*, new subspecies**

Labrum with front margin in female prominently and suddenly tridentate, in male not so suddenly or strongly tridentate; antennal scape with a dozen or more long white hairs at base, middle, and apex; gena without hair; front of head, female, with three white hairs each side of middle on level of front angle of eyes, male with numerous white hairs; thorax with very sparse long white hairs at sides, the inner row erect; elytra, male and female, short, broad, gradually widening towards apical fifth where they are conjointly rounded to apex, without any spine. Elytral markings none; elytral color yellow green.

TYPE LOCALITY: Forestburg, [Montague County], Texas, holotype male, allotype female, March, 1928 (Calder collection), and 47 paratopotypes. Holotype and allotype and 23 paratopotypes in the American Museum of Natural History; the others

in the collections of the University of Michigan, South Dakota State College, and J. H. Robinson.

DISTRIBUTION: North central Texas, south of the Red River from Montague County to Brown County and east to Tarrant County.

Differs from *rugifrons* (northeastern states) and its black phase (*modesta*) in the immaculate elytra, more rugose thorax, less rugose front of head, and lack of any black phase; from *unicolor* (southeastern states) and its black phase (*nigrior*) in the more rugose thorax, less rugose front of head, lack of black phase, and light yellow green color; from *lecontei* (central eastern states and eastern Canada) and *criddlei* (northern North Dakota and Canada) in the immaculate elytra and green color; from *scutellaris* (central states, western Canada, and northern Texas) in the green color; from *rugata* (Louisiana, eastern Texas) in light yellow green color.

DISCUSSION: For comparison of *flavoviridis* with *rugata*, see discussion under that subspecies. *C. s. flavoviridis* is intermediate between *rugata* to the east and *scutellaris* to the north, but is more closely related to the latter. Both *flavoviridis* and *scutellaris* have yellow or coppery reflections on the elytra, even though *flavoviridis* has the elytra predominantly light green and *scutellaris* has them predominantly red with some green at the base. Of 65 specimens of *scutellaris* only five have more green than red on the elytra; of these five, one is probably wrongly labeled (Fort Garland, Colorado, June, Osler, Calder collection), and one has white markings at the apex; the other three (two from Alva, Wyoming, one from "Ks.") are indistinguishable from the yellowest of the *flavoviridis* specimens.

A population of *C. s. scutellaris* has been seen from Cooke County, Texas, just south of the Red River which is very near the northernmost range of *flavoviridis*. At Denton County, just south of Cooke County, an intermediate specimen has been taken which is not quite so red as *scutellaris*, but more red than any *flavoviridis*.

Cicindela scutellaris rugata, new subspecies

Similar to *C. s. flavoviridis*, but differs from that subspecies by being purplish or blue green, not yellow green.

TYPE LOCALITY: Vowell's Mill, Natchitoches County, Louisiana, holotype male, allotype female, and nine paratopotypes, in

the collection of the American Museum of Natural History. Twenty-three paratypes from: Texas: Atlanta, May 7, 1949 (J. H. Robinson), 20; Anderson County, March 26, 1938 (J. H. Robinson), one; Grimes County, May 13, 1936 (J. H. Robinson), one; Kaufman County, June 2, 1934 (J. H. Robinson), one. Seven paratypes in the American Museum of Natural History; the others in the collection of J. H. Robinson.

DISTRIBUTION: Western Louisiana and eastern Texas as far southwest as Bexar County and northwest to Kaufman County.

Differs from *rugifrons* (northeastern states) and its black phase (*modesta*) in the immaculate elytra, more rugose thorax, less rugose front of head, and lack of any black phase; from *unicolor* (southeastern states) and its black phase (*nigrior*) in more rugose thorax, less rugose front of head, lack of black phase; from *lecontei* (central eastern states and eastern Canada) and *criddlei* (northern North Dakota and Canada) in immaculate elytra and green color; from *scutellaris* (central states, western Canada, northern Texas) in green color; from *flavoviridis* (north central Texas) in its purplish or blue green color, not yellow green.

DISCUSSION: This subspecies is intermediate between *unicolor* to the east and *flavoviridis* to the west, having the purple or blue green coloration of *unicolor* and the more rugose thorax and less rugose head of *flavoviridis*.

Though so similar to *unicolor* in coloration, *rugata* can always be told from that race by comparison of the thoracic structure and the rugosity on the front of the head. In *unicolor* the thorax, while not entirely smooth, in that it has a few impressed lines, still is smooth between these lines; in *rugata* the entire thorax is much wrinkled between all the impressed lines, which are numerous. In the case of the front of the head, just behind the clypeus, it is *unicolor* that is more rugose, having the wrinkles deeply cut, and *rugata* that is less rugose, the wrinkles being shallower. (The difference is seen best in the females.)

The thorax and head are similar in rugosity in *rugata* and *flavoviridis*, but here the elytral color differs. *Cicindela s. rugata* has the elytra purple or sometimes dull blue green, whereas *flavoviridis* has them yellow green, sometimes light green. Some few *rugata* approach in color the *flavoviridis* specimens that have the least amount of yellow in the elytra, but it is still a different shade of green, and *rugata* never has any yellow in its coloring. Also the green *rugata* that might be confused with the green

flavoviridis (no yellow in the elytra) tend to have the thorax the same shade of green, while in *flavoviridis* the thorax is a deeper shade, usually mixed with blue.

Intergrades between these two subspecies appear to be present in the populations occurring at Dallas, Dallas County, and at Gatesville, Coryell County, Texas.

Cicindela lemniscata rufipes, new subspecies

Labrum with front margin unidentate and strongly sinuate on either side of the tooth; antennal scape with a single long white hair at apex only; gena without hair; front of head without hair; thorax with reclining white hairs on sides only; elytra, male, almost parallel to apical fifth, then conjointly rounded at apex, slightly truncate, with acute spine at suture. Elytral markings consisting of a longitudinal band from base to apex and touching the margin in those places only. The band usually sinuate before apex in portion where middle band would be expected. Legs metallic red.

TYPE LOCALITY: Van Horn, Culberson County, Texas, holotype male, allotype female, July 10, 1948 (C. and P. Vaurie), and 314 paratopotypes, in the collection of the American Museum of Natural History. One hundred and twenty-nine paratypes from: *New Mexico*: Alamogordo (G. V. Krockow), three; Alamogordo, Otero County, 4300 feet, July 25, 1948 (G. E. Ball), 24; Carlsbad Cavern, Eddy County, August 18, 1935 (T. H. and G. O. Hubbell), one; 5 miles south of Mesilla, Dona Ana County, July 25, 1948 (G. E. Ball), one. *Texas*: Marathon, Brewster County, June 13, 1948 (M. Cazier), one; Glenn Spring, Brewster County, July 24, 1928 (F. M. Gaige), two; Hot Springs, Terlingua Creek, Brewster County, July 6, 1948 (C. and P. Vaurie), three; Boquillas, Brewster County, July 7, 1948 (C. and P. Vaurie), 21; Terlingua, Brewster County, July 3, 1948 (C. and P. Vaurie), one; 15 miles north of Cooper's Store, Brewster County, July 8, 1948 (C. and P. Vaurie), one; Sheffield, Pecos County, June 30, 1948 (C. and P. Vaurie), three; Davis Mountain Junction, Reeves County, July 9, 1948 (C. and P. Vaurie), one. *Mexico*: *Tamaulipas*: Nuevo Laredo (Höge), one; the following specimens taken on David Rockefeller Mexican Expedition: *Chihuahua*: Delicias, 4150 feet, July 11, 1947, eight; 63 miles west of Santa Barbara, 5500 feet, July 20, 1947, nine; Samalayuca, June 24, 1947, seven; 42 miles southwest of Camargo, 4900 feet, one; Valle de Olivos,

5500 feet, July 20, 1947, one; 1 mile east of La Saucedá, 7000 feet, July 21, 1947, one; 10 miles south of Las Delicias, July 13, 1947, one; Santa Barbara, 6300 feet, July 18, 1947, two; 20 miles southwest of Camargo, 4500 feet, July 13, 1947, six. *Durango*: Cuencame, 5500 feet, August 19, 1947, one; San Juan del Rio, 5200 feet, July 30, 1947, six; Pedricena, 4500 feet, August 19, 1947, 11; Nombre de Dios, 5900 feet, August 13, 1947, six. *Coahuila*: Cabos, 4000 feet, August 21, 1947, two; La Gloria, south of Monclova, 3300 feet, August 24, 1947, three; Guadalupe, August 23, 1947, one. All in the collection of the American Museum of Natural History.

DISTRIBUTION: Southern New Mexico, southwestern Texas, including the Rio Grande south to Laredo, and the northern Mexican states of Chihuahua, Tamaulipas, Durango, and Coahuila.

Differs from *lemniscata* in the strongly pigmented metallic red legs.

DISCUSSION: The entire leg is red, or red with green reflections, in *rufipes*, while in *lemniscata* (southern Arizona, northern Mexico west of the Sierra Madre Occidental), though the tarsi are colored as in *rufipes* and the tibiae are occasionally slightly pigmented, the femora are consistently colorless, in fact virtually transparent. In a few specimens from Salome, Arizona (four of 85), and Gila Bend, Arizona, the femora show a tinge of green along the front edge.

Neither subspecies shows any geographic variation in elytral markings, which is unusual; the longitudinal band may be broader or narrower or interrupted near the apex or at the middle, but these differences are scattered throughout the ranges of both subspecies.

Intermediate populations between *lemniscata* and *rufipes* are found in southern New Mexico at Deming, Lordsburg, and Grant County. These have a small amount of green pigment on the front of the otherwise colorless femora.

The type and paratopotypes were collected at night after 9:30 p.m. when they were exceedingly abundant at all the lighted places in the desert town of Van Horn. One specimen was taken by day in a dry creek bed.

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NOTES ON SOME ASIATIC TITMICE¹

BY CHARLES VAURIE

INTRODUCTION AND GENERAL REMARKS

This paper is a report on the titmice collected by Dr. Koelz in Iran, Afghanistan, and India. Over a thousand specimens were collected, and the present studies are based on these and a still larger number from the collection of the American Museum of Natural History.

Since the publication of the first three papers in this subseries new collections have been received from Dr. Koelz from northern India in Tehri, Garhwal, and Kumaon, as well as from western India in Rajputana (Sirohi) and from Junagadh and other parts of Kathiawar. The tits in these collections are incorporated in the present paper.

In the first three papers I used the term "Iran" in a restricted sense, because on Dr. Koelz's labels all localities followed by this name were situated on the Plateau or along its borders, localities in other regions bearing the well-known provincial names such as Azerbaijan, Fars, etc. Dr. Koelz, however, prefers that the term Iran be used in its present official sense denoting the whole of the country.

In the lists of specimens the term subadult (subad.) indicates that specimens are in first winter plumage.

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I have received, as usual, much assistance from Dr. Ernst Mayr, and I deeply appreciate his friendly advice and interest in these studies.

¹ Notes from the Walter Koelz Collections, Number 4. The previous papers in this subseries are: Number 1, American Museum Novitates, no. 1406, 1949; Number 2, American Museum Novitates, no. 1424, 1949; Number 3, American Museum Novitates, no. 1425, 1949.

To Mr. Jean Delacour I am grateful for suggestions and his kindness in examining some specimens of *Parus cyanus* and *Parus major* in the Paris and British Museums. He has always been interested in *Parus major* and together we have prepared a revision of the entire species which is being published elsewhere (L'Oiseau, in press).

Mr. B. Biswas has helped with Indian localities and has furnished me with the measurements of a series of *Aegithalos concinnus* taken by him in the British Museum. I have also had the pleasure of working out with him the plumages of *Parus xanthogenys*.

SUBFAMILY PARINAE

PARUS LUGUBRIS

Three races occur in Iran: *hyrcanus* Zarudny and Loudon, 1905 (type locality, Rustamabad, Gilan), *dubius* Hellmayr, 1901 (type locality, Shiraz, Fars), and *kirmanensis* (type locality, Deh Bakri, Kirman) recently described by Koelz (1950, Amer. Mus. Novitates, no. 1452, p. 8). *P. l. dubius* is a new name for the pre-occupied *persica* of Prazák (1895, Ornith. Jahrb., p. 81), based on *Parus lugubris* ? of Blandford (1876, Eastern Persia, p. 229) whose specimens came from Shiraz.

The range of *hyrcanus* is along the southern Caspian, *kirmanensis* so far is known only from the mountains of Kirman, and *dubius* is found in the Zagros from Fars to Kermanshah. The first two are apparently restricted to Iran, but *dubius* probably continues in the mountains over the Iranian border.

Comparison of the Koelz specimens (listed below) with a limited number of specimens in the collection of the American Museum of Natural History, of nominate *lugubris*, *lucens*, and *splendens* from southeastern Europe and of *anatoliae* from Asia Minor, shows that the specimens of *hyrcanus* from the region of Gorgan in adult and juvenal plumage are tinged with rust on the breast, belly, and flanks, while these parts are creamy or dingy white in all the other populations of the species examined. The crown in the three adults of *hyrcanus* is brown as in nominate *lugubris*, *lucens*, and *splendens*, but the brown is warmer, "browner," and less sooty.

The crown is black in *anatoliae*, *dubius*, and *kirmanensis*, the three races differing from one another by the color of the back. In *anatoliae* the mantle is distinctly darker and grayer than in *kirmanensis* and much darker than in *dubius*; in *kirmanensis*

the mantle is darker than in *dubius* and browner than in either *anatoliae* or *dubius*. In both *kirmanensis* and *dubius* the crown is pure velvety black; in two adult specimens of *anatoliae* (one of which is the type) the black is not so deep, but Paludan (1938, Jour. Ornith., vol. 86, p. 604) could see no difference in the intensity of the black.

MOULT: In the Zagros, adult specimens start their post-nuptial moult in May. In this region, the moult had not started in specimens taken from May 5 to 8 but had begun with that of the inner primaries in specimens taken from May 26 to 31. A specimen taken on October 29 at Durud in Luristan is interesting this specimen, a male, which appears to be in first winter plumage in that it had moulted the contour feathers and greater wing coverts but still retained the juvenal primary coverts and wing feathers, had also grown a complete set of adult tail feathers.

In the region of Gurgan adults taken from July 22 to 23 are in the midst of a complete post-nuptial moult, and at the same time two immatures have started to moult into first winter plumage through a partial post-juvenal moult involving only the contour feathers and greater wing coverts.

TABLE 1

MEASUREMENTS OF FULL ADULTS IN IRANIAN POPULATIONS OF *Parus lugubris*

Race and Region	N	Wing	Tail	Bill
<i>kyrcanus</i>				
Gurgan	2 ♂	Moult	Moult	12 5, 13 0 —
Gurgan	1 ♀	Moult	Moult	12 5 — —
<i>dubius</i>				
Kermanshah	4 ♂	73 5-76 0 (74 5)	57-62 (59 7)	13 5-14 0 (13 8)
Kermanshah	2 ♀	71 0, 73 5 —	57, 59 —	14 0, 14 0 —
Luristan	2 ♂	75+, 75+ —	59, 59 —	13 5, 14 0 —
Bakhtiari	8 ♂	73 0-78 0 (75 4)	58-63 (60 2)	13 0-14 0 (13 6)
Bakhtiari	8 ♀	73 0-74 0 (73 5)	58-60 (59 2)	12 0-14 0 (13 5)
Fars	2 ♂	75 0, 75+ —	57+, 59 —	13 0, 14 0 —
<i>kirmanensis</i>				
Kirman	12 ♂	75 0-78 0 (76.5)	57-64 (60 6)	12 5-14 0 (13 2)
Kirman	6 ♀	71 0-76 0 (74 1)	57-61 (59 5)	12 5-13 5 (13.0)
Type (Deh Bakri)	1 ♂	78.0 — —	64 — —	14.0 — —

***Parus lugubris hyrcanus* Zarudny and Loudon**

IRAN: Region of Gurgan: Dimalu, July 22-23, 1940, 2 ad. ♂, 1 imm. ♂, 1 ad. ♀, 1 imm. ♀.

***Parus lugubris dubius* Hellmayr**

IRAN: Kermanshah: Surkhidizeh, January 10, 1941, 4 ad. ♂, 2 ad. ♀. Luristan: Durud, March 2, 1 ad. ♂, October 29, 1 subad. ♂; Chamchid, May 26, 1940, 1 ad. ♂; Kalvar, May 27-30, 2 imm. ♂, 1 imm. ♀, 1 unsexed ad. Bakhtiari: Ti, February 1-12, 1941, 5 ad. ♂, 1 subad. ♂, 1 ad. ♀, 3 subad. ♀, May 31, 1940, 1 ad. ♀; Imarat, February 14-19, 1941, 1 ad. ♂, 1 subad. ♂, 5 ad. ♀; Pashmshurun, April 30-May 10, 1940, 1 imm. ♂, 1 ad. ♀, 2 imm. ♀, 1 unsexed imm.; Damavar, May 5, 2 ad. ♂. Fars: Niriz, March 28, 1 ad. ♂; Dastarjin, April 8, 1 ad. ♂.

***Parus lugubris kirmanensis* Koelz**

IRAN: Kirman: Deh Bakri, January 27-28, 1940, 2 ad. ♂, January 28, 1 ad. ♂ (the type of *P. l. kirmanensis*), January 29-30, 2 ad. ♂, 3 ad. ♀; Gudar Ushturu, January 30, 1 ad. ♂; Dehidisk, January 31-February 1, 2 ad. ♂, 1 ad. ♀; Guragan, February 10, 1 ad. ♀; Maskun, February 11-13, 4 ad. ♂, 1 ad. ♀.

***Parus ater gaddi* Zarudny**

IRAN: Region of Gurgan: Gozlu, July 15-16, 1940, 2 ad. ♀; Dimalu, July 16-24, 2 ad. ♂, 1 unsexed ad.; Karimserai, July 21, 2 ad. ♂, 3 ad. ♀; Kherat, July 26, 1 ad. ♀, September 30, 1 subad. ♂, 1 unsexed ad.; Gurgan, September 30, 1 ad. ♀, 1 subad. ♀.

All the July specimens are in full moult and cannot be used for comparison. Of the four September specimens only two are fully adult; the other two are in first winter plumage, but the coloration of their body plumage is identical in one case and in the other very close to that of the two adults. These four specimens differ from a small series of *micchalowskii* from the Caucasus (four from Wladikawkaz) and Armenia (two from Kedlabek, north of Lake Sevan) by being browner, less gray, on the mantle and flanks. Two specimens of *derjugini* from Lasistan in western Transcaucasia are still grayer than the specimens of *micchalowskii* and have a longer and thinner bill. Four specimens of *chorassanicus* from Ashkhabad are very similar to the four specimens of *gaddi*, but the brown of the mantle and flanks is a little paler. Specimens from the Zagros were not available; the birds of this region have been described as *phaeonotus* by Blanford, a race which, according to Hartert, is darker brown than *gaddi* (1921, Die Vögel der paläarktischen Fauna, p. 2115).

MOULT: In specimens taken from July 15 to 26 the moult is at its height, the body plumage, wing, and tail moulting simultaneously. The two adults taken on September 30 have finished the moult, but the two subadults still show a few last traces of moult in the body plumage.

MEASUREMENTS: Wing, adult female, 70; unsexed adult, 67. Tail, adult female, 48; unsexed adult, 47. Bill, four males, 11-12 (11.6); seven females, 11.0-12.5 (11.3).

***Parus ater aemodius* Hodgson**

INDIA: Northern Bengal: Darjeeling district, Tiger Hill, December 23, 1936, 1 ad. ♂.

This specimen measures: wing, 62; tail, 42; bill, 9.

***Parus nuchalis* Jerdon**

INDIA: Rajputana, Sirohi: Sirohi, December 25, 1948, 1 ad. ♂.

This specimen, in perfect plumage, has just finished the post-nuptial moult. Another adult male from Rajputana (Sambhar) and this specimen measure: wing, 68, 71; tail, 48, 52; bill, 12.0, 12.5.

This species, so very definitely associated with the dry north-western fringes of the Indian Plateau, has also been taken in southern India. Jerdon's type, collected by shikaris, is said to have come "from the Eastern Ghats west of Nellore." Despite "a very special look-out for it," the survey of the Eastern Ghats failed, however, to find it, and the only well-authenticated record for southern India is the one specimen taken at Satyamangala in the Biligirangan Hills (Ali, 1942, Jour. Bombay Nat. Hist. Soc., vol. 43, p. 145). In the north, outside Rajputana, it is found, according to Ali (1945, Birds of Kutch, p. 2), in Kutch and northern Gujarat. It is resident in these regions but patchy in its distribution and rather rare, the patchiness of its distribution probably being associated with the scarcity of suitable habitats.

PARUS CAERULEUS

The 125 specimens of this species collected by Koelz in Iran were compared with 65 specimens in the collection of the American Museum of Natural History from Scandinavia, East Prussia, Germany, and the region of Orenburg in eastern Russia. Despite this large amount of material I lack specimens from two important

regions. I have but one specimen from Transcaucasia and none from the Caspian side of the Elburz, except at its eastern extremity.

Examination shows that three forms stand out: a dark one from Scandinavia, East Prussia, and Germany (nominate *caeruleus*), a pale form, very yellowish on the back, from the region of Orenburg (*orientalis*), and a smaller, very pale form from the Zagros (*persicus*). According to my specimens two other forms can be distinguished, but the differences are not so distinct. These are *satunini* in northwestern Iran and *raddei* in northern Iran.

Parus c. orientalis was described from the region of Orenburg by Zarudny and Loudon. This form is not recognized by Dementiev, who makes it a synonym of nominate *caeruleus* (1935, L'Oiseau, p. 74). However, my 24 specimens from Orenburg and region, collected by Zarudny, fully support Hartert when he states that *orientalis* is a "good" race, considerably paler and [much] yellower on the back than nominate *caeruleus* (1921, Die Vögel der paläarktischen Fauna, p. 2112).

In 1908 Zarudny described birds from Lenkoran and Kumbaschinsk in Russian Talych as *satunini*. This race is stated to be pale, more or less intermediate between nominate *caeruleus* and *persicus*, paler than *raddei*, and lacking the yellow on the back of *orientalis*. My specimens from Azerbaijan fit this description perfectly. Three additional names have been applied by Buturlin to birds from the Caucasus and Transcaucasia, but these names have all been made synonyms of *satunini* by the Russian authors. A specimen from Transcaucasia taken at Kutaïs, the type locality of one of Buturlin's names (*colchicus*), is very slightly paler above and below than my specimens from Ardebil and Namin (about 50 kilometers from Lenkoran, the type locality of *satunini*) but is identical with specimens from central and western Azerbaijan.

Zarudny stated that *satunini* was also found at Kazvin and in the Transcaspiian mountains. I have only four immature specimens from Khorasan taken at Kotaliyekchinar in the northern mountains, and these specimens are not diagnostic. At Karaj to the east of Kazvin my specimens are distinctly darker green above and darker yellow below than the specimens from Azerbaijan.

These specimens appear to belong to the darker *raddei*, which was described by Zarudny from "Astrabad, Mazanderan, and

Gilan'' as being smaller than nominate *caeruleus* and more strongly tinged with green and darker on the back. This is supported by Stresemann (1928, Jour. Ornith., vol. 76, p. 367) who also found that his specimens from Kuramabad in Gilan were more strongly yellow below.

Unfortunately I have no specimens from the coastal districts of the Elburz, but towards its eastern extremity four specimens from Gurgan and near-by Kherat in fresh plumage are not separable by the color of the back from specimens of nominate *caeruleus* in comparative plumage from Scandinavia, East Prussia, and Germany. Three specimens from Karaj are identical with the Gurgan and Kherat birds. In these seven specimens the yellow of the under parts is perhaps very slightly stronger than in nominate *caeruleus*, but, although too few, the measurements are not smaller (table 2).

On the basis of my specimens from Karaj, Gurgan, and Kherat, I could not recognize *raddei* as distinct from nominate *caeruleus*, but I believe that *raddei* is probably a valid race, since the measurements of both Zarudny and Stresemann (table 2) show it to be smaller, and both authors agree that it differs in coloration. The type locality, however, is vague and also unsatisfactory, as the birds of Gurgan (formerly Astrabad) may not be typical *raddei*.

As stated, *persicus* is very pale and unmistakably different from the other four races. Its bill averages shorter, and, as Blanford stated, it is also thinner.

A cline of decreasing pigmentation runs from east to west in Azerbaijan and from northwest to southeast along the Zagros. This cline is slight but can be appreciated in my excellent series of adult and first winter birds in very fresh or almost fresh plumage taken in these two regions from October 30 to February 13. Specimens from eastern Azerbaijan (Namin, Ardebil, and Sarab) are slightly more heavily pigmented than birds from central Azerbaijan (Tabriz, Livan, and Maraghe), and these in turn are very slightly darker than specimens from Rezaieh on the western side of Lake Urmia and from Saujbulagh south of the lake. I have no specimens between Saujbulagh and Hamadan. At Hamadan the birds are now too pale and too small for *satunini*, but the birds of Hamadan are very slightly darker than those of Kermanshah, and these in turn are very slightly darker than those of Bakhtiari. I would expect the trend to continue and the birds of Fars to be palest. But unfortunately all my specimens from

Fars were taken in April and are no longer comparable; in this worn plumage they are identical with other worn specimens taken in Luristan and Bakhtiari in April and May. All the differences mentioned above are extremely subtle, but they are appreciable in series.

TABLE 2

MEASUREMENTS OF FULLY ADULT MALES AND FEMALES IN
SOME POPULATIONS OF *Parus caeruleus*

(Fresh or not badly worn plumage only, except where stated)

Locality or Region	N	Wing	Tail	Bill
<i>P. c. caeruleus</i>				
Sweden, Norway	2 ♂	67.5, 70.0 —	53, 53 —	9.5, 10.0 —
Sweden, Norway	4 ♀	65.0–66.5 (65.5)	51–53 (52.0)	9.5–10.0 (9.7)
East Prussia	5 ♂	67.0–69.0 (68.0)	51–55 (53.6)	10.0–11.0 (10.4)
Marburg, Hesse	7 ♂	66.0–71.0 (68.8)	50–55 (51.8)	9.0–11.0 (9.8)
<i>P. c. orientalis</i>				
Orenburg, E. Russia	10 ♂	68.0–71.0 (69.2)	52–56 (54.0)	10.0–11.0 (10.3)
Orenburg, E. Russia	6 ♀	66.0–69.0 (67.0)	50–53 (51.5)	9.5–10.0 (9.8)
<i>P. c. satunini</i>				
Azerbaijan	10 ♂	64.0–70.0 (67.0)	48–56 (51.5)	9.5–10.0 (9.9)
Azerbaijan	10 ♀	63.0–68.0 (65.4)	48–53 (50.6)	8.5–10.0 (9.4)
<i>P. c. persicus</i>				
Hamadan	7 ♂	63.0–67.0 (65.4)	48–52 (49.5)	9.0–10.0 (9.1)
Hamadan	3 ♀	62.0–64.0 (63.0)	46–49 (48.0)	8.5–9.5 (9.0)
Kermanshah	5 ♂	64.0–68.0 (65.5)	48–50 (48.8)	9.0–10.0 (9.6)
Kermanshah	6 ♀	62.5–65.0 (63.9)	47–51 (49.0)	8.5–9.5 (9.1)
Luristan, Bakhtiari	19 ♂	62.0–68.0 (66.1)	46–53 (49.8)	8.5–10.0 (9.3)
Luristan, Bakhtiari	11 ♂ ^a	62.0–67.0 (64.4)	47–51 (49.0)	
Luristan, Bakhtiari	3 ♀	62.5–64.0 (63.8)	46–50 (47.3)	9.0–9.5 (9.3)
Fars	2 ♂ ^a	65.0, 66.0 —	49, 52 —	9.0, 9.5 —
Fars	2 ♀ ^a	63.0, 64.0 —	48, 49 —	9.0, 9.0 —
<i>P. c. raddei</i>				
Kuramabad, Gilan ^b	5 ♂	62.0–67.0 (64.0)	— — —	— — —
Kuramabad, Gilan ^b	3 ♀	59.0–62.0 (60.7)	— — —	— — —
Karaj	2 ♂	65.0, 67.0 —	47, 49 —	9.0, 10.0 —
Karaj	1 ♀	65.0 —	48 — —	9.0 — —
Gorgan	2 ♂	67.0, 69.0 —	50, 52 —	8.5, 10.0 —
Gorgan	2 ♀	63.0, 63.0 —	45, 48 —	9.5, 9.5 —

^a Badly worn.

^b Stresemann (1928, Jour. Ornith., vol. 76, p. 367).

To summarize:

Parus caeruleus orientalis Zarudny and Loudon, 1905 (type locality Orenburg) is a well-characterized race.

Three races occur in Iran:

A. *P. c. satunini* Zarudny, 1908 (type locality Lenkoran); range in Iran: Azerbaijan, and, according to Zarudny, found at Kazvin, and [?] in the Transcasian mountains.

B. *P. c. raddei* Zarudny, 1908 (type locality "Astrabad, Mazanderan, and Gilan"); restricted to Iran: in the Elburz and the southern Caspian districts east of the range of *satunini*.

C. *P. c. persicus* Blanford, 1873 (type locality Shiraz); range in Iran: the Zagros from somewhere north of Kermanshah into Fars.

According to my specimens the characters of the five races included in this study may be summarized as follows:

RACE	COLORATION OF THE BACK	COLORATION OF THE LOWER PARTS	SIZE
<i>caeruleus</i>	Darkest and greenest	Dark; yellow less pure, tinged with grayish green	Large
<i>orientalis</i>	Pale, with strong yellowish tinge	Pale; yellow pure and bright	Large
<i>satunini</i>	Paler than <i>caeruleus</i> , less green, more grayish; darker than <i>orientalis</i> , less yellowish, more grayish	Like <i>orientalis</i> but yellow averages stronger	Large
<i>raddei</i>	Like <i>caeruleus</i> , but said to be darker with more gray	Like <i>caeruleus</i> , but yellow averages slightly stronger	Small
<i>persicus</i>	Very pale and distinctly grayish without yellowish tinge of <i>orientalis</i>	Palest; yellow very weak	Small and with thin- nest bill

MOULT: Adults have a complete post-nuptial moult. In Iran this moult is well advanced in specimens taken from July 15 to 24 in the region of Gorgan, and nearing completion in a specimen from July 27. In Azerbaijan, however, a specimen taken on October 30 is still showing a few last traces of moult on the crown.

According to my specimens, immatures in Iran may moult into first winter plumage a little later than adults, for the moult is just starting in specimens taken from July 24 to 27 in the region of Gorgan, August 3 to 5 in Khorasan, and August 13 in Luristan.

The first feathers to be changed are the lesser wing coverts. In a specimen taken on November 2 in Azerbaijan the moult is virtually finished except for a very few last traces in the body plumage. In the moult into first winter plumage, all the body plumage and wing coverts except for the primary coverts are renewed. The primaries, secondaries except two or three of the innermost, and the rectrices, except for the central pair, are not changed.

***Parus caeruleus satunini* Zarudny**

IRAN: Azerbaijan: Tabriz, October 30, 1940, 1 ad. ♂, 1 subad. ♂, 3 ad. ♀, 1 subad. ♀, 1 unsexed ad.; Ardebil, November 2-4, 1 subad. ♀, 2 unsexed subad.; Namin, November 6, 1 ad. ♂; Sarab, November 8-9, 2 ad. ♂, 2 ad. ♀, 2 subad. ♀; Livan, November 14-15, 1 ad. ♀, 1 subad. ♀; Maraghe, November 25-December 1, 2 ad. ♀, 1 unsexed ad.; Saujbulagh, November 26-December 3, 3 ad. ♂, 1 subad. ♂, 1 ad. ♀, 1 unsexed subad.; Rezaieh, December 6-8, 3 ad. ♂, 2 ad. ♀, 1 subad. ♀; Khoi, December 10, 1 subad. ♀.

***Parus caeruleus raddei* Zarudny**

IRAN: Region of Tehran: Karaj, January 19-20, 1944, 1 ad. ♂, 1 ad. ♀, November 15, 1945, 1 ad. ♂. Mazenderan (region of Gorgan): Gozlu, July 15, 1940, 1 ad. ♂; Germabdasht, July 24, 1 ad. ♂, 1 imm. ♀; Kherat, July 27-September 30, 2 ad. ♂, 2 ad. ♀, 1 imm. ♀; Gorgan, September 30, 1 ad. ♂. Khorasan: Kotaliyekchinar, August 3-5, 1 imm. ♂, 3 unsexed imm.

***Parus caeruleus persicus* Blanford**

IRAN: Region of Hamadan; Hamadan, December 20, 1940-January 18, 1941, 7 ad. ♂, 3 ad. ♀. Kermanshah: Kangavar, December 23, 1940, 1 ad. ♂, 1 unsexed ad., 1 unsexed subad.; Kermanshah, December 26, 1 ad. ♂, 1 ad. ♀; Qasr i Shirin, December 28, 1940-January 6, 1941, 3 ad. ♂, 1 subad. ♂, 5 ad. ♀, 2 subad. ♀, 1 unsexed subad.; Surkhidizeh, January 10, 1 ad. ♀. Luristan: Durud, January 25, 1 ad. ♀, August 13, 1 unsexed imm.; Kalvar, May 28-30, 1940, 3 ad. ♂, 2 imm. ♂, 1 ad. ♀, 1 imm. ♀. Bakhtiari: Damavar, May 4, 1 ad. ♂ "nesting"; Pashmshurun, April 30-May 9, 9 ad. ♂, half of them "nesting"; Ti, February 1-13, 1941, 12 ad. ♂, 1 ad. ♀, May 30, 1940, 1 imm. ♂; Imarat, February 15-19, 1941, 6 ad. ♂, 1 ad. ♀. Fars: Dastarjin, April 8-9, 1940, 2 ad. ♂, 1 subad. ♂, 2 ad. ♀, 1 subad. ♀.

***Parus cyanus flavipectus* Severtzow**

AFGHANISTAN: Sufian, July 18, 1937, 1 imm. ♂; Targaran, July 19, 2 ad. ♂, 2 imm. ♂, 1 imm. ♀, 1 unsexed imm.; Iskan, August 3, 1 ad. ♂, 1 imm. ♀; Gurzan, October 5, 1939, 1 ad. ♀; Burchao Pass, October 13, 1 ad. ♀.

These specimens constitute the first record of the species for Afghanistan.

In the 1937 series from northeastern Afghanistan the three

adults are extremely worn and cannot be used for comparison, but the six immatures are identical with three immatures of *flavipectus* from Ferghana.

The two adult females taken farther west at Gurzan and at the Burchao Pass in the Bend i Turkestan Range in October, 1939, are in very fresh plumage, the body plumage still showing a few last traces of moult. They are very pale, powder gray, on the back. In adult specimens of *flavipectus* in fresh plumage taken in Ferghana (mostly at Margelan) three females are duller, slightly darker, and bluer, and four males are bluer than the females from both Ferghana and the Bend i Turkestan. The differences, however, are undoubtedly due to sex and the age of the specimens. In their review of the species, Dementiev and Heptner (1932, *Alauda*, pp. 284-291) noticed that males are bluer and darker than females, and that with the age of the specimens the gray of the mantle becomes duller and bluer in both sexes. My Ferghana specimens are all old skins collected from 1878 to 1893. Sex or age of the specimens apparently does not seem to affect the coloration of the lower parts or affects it so slightly that I cannot separate the sexes or the old skins of Ferghana from the recent ones from the Bend i Turkestan.

Since I have failed to find individual measurements of *flavipectus* in the literature, the individual measurements of all adults that are not moulting are given here.

Afghanistan: Wing: males (very worn), 65, 66; females (fresh), 64, 64. Tail: males (very worn), 59, 60; female (fresh), 58. Bill from skull: males, 11, 11, 11.5; females, 10.5, 11.

Ferghana: Wing: males (fresh), 66, 66, 66.5, 68; females (fresh), 64, 65, 66. Tail: males (fresh), 57, 61, 62, 62.5; females (fresh), 55, 56, 58. Bill: males, 10.5, 11, 11, 11; females, 10.5, 11, 11.

MOULT: In adults a complete post-nuptial moult takes place from about the middle of July to early October. Of the two adult males taken on July 19 in the northeast, one is extremely worn but has not started to moult, and in the other the moult has barely started, the first feathers to be replaced being some of the inner secondaries. In another adult male taken on August 3 in the same region the moult is well advanced, the body, wing, and tail feathers moulting simultaneously. Both of the October females show traces of moult in the body plumage, and on the specimen taken on October 5, the three outer pairs of rectrices are from a

third to a half grown. The immatures taken from July 18 to August 3 have not begun to moult into first winter plumage.

Parus cyanus carruthersi Hartert

The measurements given by Hartert in the description of his *Parus flavipectus carruthersi* (1917, Bull. Brit. Ornith. Club, vol. 38, p. 19) must be corrected to: wing length of males, 63 (type), 66; female, 63; unsexed adult, 64. Hartert had given the wing measurements as 93 and 96 in the males, 92 in females, and 94 for the unsexed adult, and in 1921 (Die Vögel der paläarktischen Fauna, pp. 2113–2114) had repeated the erroneous measurements.

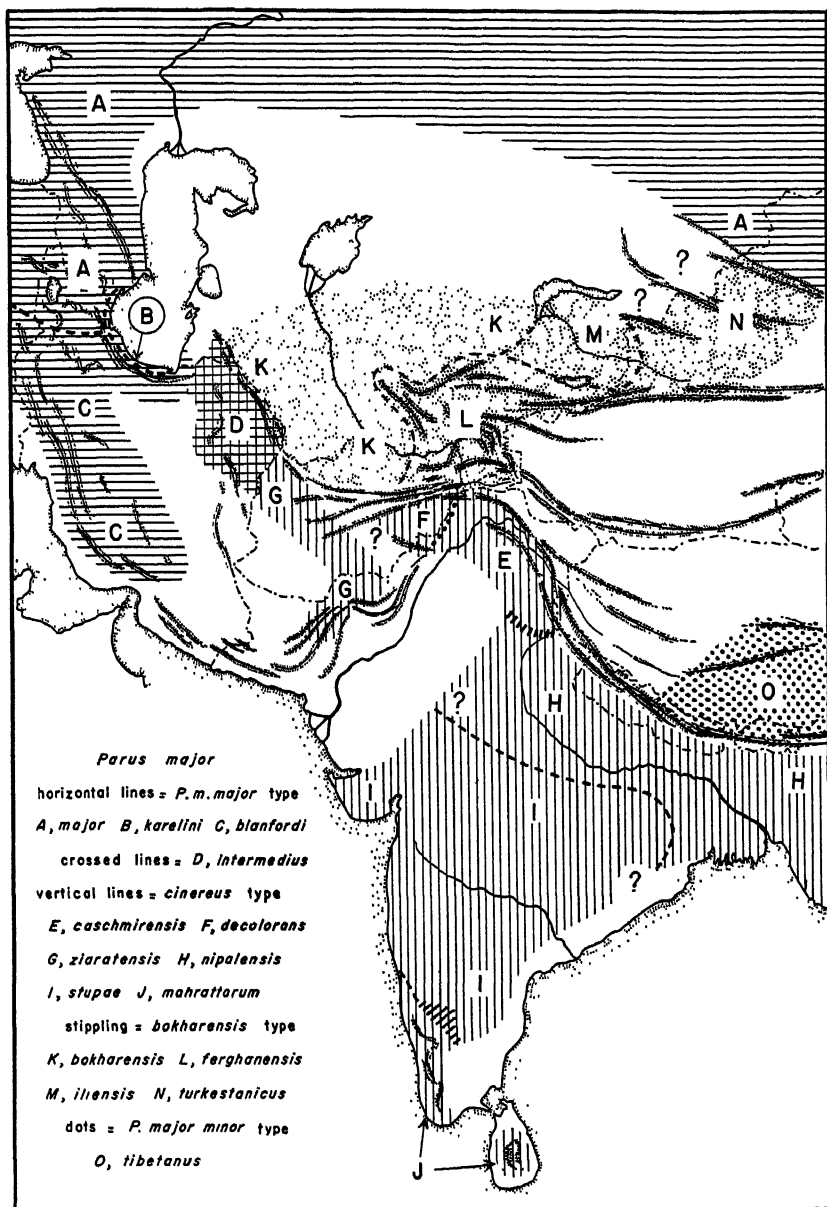
This *lapsus calami* has been corrected by Mr. Jean Delacour who had the kindness to reexamine for me the original specimens from Samarkand in the British Museum. I quote his notes in full, as the validity of *carruthersi* needs to be confirmed, its only appearance in the literature being limited, despite several reviews of *Parus cyanus*, to the two references cited above. He found *carruthersi* to be a well-marked form, being "Smaller than *flavipectus* from Ferghana whose wing measures 65–70, crown grayer and darker, also back and throat, belly less pure white, more 'dirty' and breast less clear yellow. Less white in the tail." Compared to *berezowskii* from the Nan Shan he found *carruthersi* to be "much darker."

The tail measured by Delacour is: males, 59 (type), 61; female, 59; unsexed adult, 59.

PARUS MAJOR

This species varies geographically throughout its enormous range and, as a result, has been split into innumerable races. Meinertzhagen (1928, Ibis, pp. 530–533) recognizes no fewer than 41 races, and since then a number of others have been described. This review deals only with the races found in the Iranian region, Turkestan, India, and Ceylon.

Within this region, Meinertzhagen recognizes nine races: nominate *major*, *blanfordi*, *cinereus*, *mahrattiarum*, *planorum*, *caschmirensis*, *intermedius*, *bokharensis*, and *jitnikowi*. Since Meinertzhagen, *cinereus* has been restricted to Java, and *planorum* and *jitnikowi* are no longer recognized. But five names synonymized by Meinertzhagen have been revived (*karelini*, *nipalensis*, *ferghanensis*, *iliensis*, and *turkestanicus*), and four additional races have been described—the first (*ziaratensis*) by Whistler in 1929,

FIG. 1. Distribution of *Parus major* in western Asia.

and the other three (*stupae*, *meinertzhageni*, and *decolorans*) by Koelz (1939, Proc. Biol. Soc. Washington, vol. 52, pp. 61-63).

This study shows that, in the region as defined above, 14 races can be recognized: nominate *major*, *karelini*, *blanfordi*, *intermedius*, *caschmirensis*, *decolorans*, *ziaratensis*, *nipalensis*, *stupae*, *mahrattarum*, *bokharensis*, *ferghanensis*, *iliensis*, and *turkestanicus*. The ranges are shown in figure 1. Some of these races are based on slender ground, but I have recognized all races whose characters appear to be constant.

My material from this region consists of about 650 specimens, including six types, 200 odd in the collection of the American Museum of Natural History, and 430 odd collected by Koelz. In addition, Mr. J. Delacour has had the kindness to examine for me some of the Turkestan specimens in the British Museum.

CHARACTER VARIATION

The variations affect size, proportions, and pigmentation.

VARIATIONS IN SIZE: In table 3, in the 32 populations consisting of four or more adult males that I have measured, the variations in round numbers between the averages are as follows:

Wing: 63 to 78, or about 19 per cent

Bill (from skull): 12 to 14, or about 14 per cent

Tail: 55 to 75, or about 27 per cent

The wing length does not appear to be correlated with migration. In northern Europe, where the species is migratory or partly so, my populations of adult males from Scandinavia, East Prussia, and Pskov have a mean wing length of 76.5, 76.1, and 77.1, but in supposedly sedentary populations in Persia the mean wing length in the Zagros is 76.8, 77.4, and in Khorasan, 77.0.

On the other hand there is definite evidence that the wing length is affected by altitude. In India the Himalayan populations have a wing length of 74.6 and 76.4, but those from lower altitudes in lower Nepal, lowland Assam, United Provinces, and central India have wing lengths of 64.8, 63.5, 66.8, 65.5, and 65.3. The larger race of southern India and Ceylon (*mahrattarum*) is a highland form. In Travancore, Whistler states that it is confined to the hills, going up to 6000 feet (1932, Jour. Bombay Nat. Hist. Soc., vol. 35, p. 518). In Ceylon, the same author has taken it at 5800 feet (1944, Spolia Zeylanica, vol. 23, p. 129). The true specimens of this race that I have seen from southern India were

taken at Ootacamund in the Nilgiris at an elevation of about 7500 feet.

In Iran the birds along the southern Caspian strip (*karelini*), which, as Heinrich states (1928, Jour. Ornith., vol. 76, p. 367), are restricted to the gardens of the coastal plain and the lower slopes, ascending only as high as 600 meters, are smaller than the birds found at higher altitudes in Azerbaijan, the Zagros, or the Plateau. In Turkestan, *ferghanensis* from the mountains of Bukhara and Ferghana averages larger than *bokharensis* from the lowlands of Bukhara and of Afghan Turkestan. In a detailed study based on large series it might be possible to show that throughout the whole range of the species the larger populations come from the higher altitudes.

The size of the bill and the length of the tail, with the significant exception of the Turkestan populations in the case of the latter, appear to be correlated on the whole with the body size as expressed by the length of the wing. In nominate *major* the bill is proportionately a little smaller.

VARIATIONS IN PROPORTIONS: The variations in the tail length are best studied in terms of the proportion of the length of the tail to that of the wing. This tail index, in the populations measured by me in table 3 in which there are four or more specimens, runs within the narrow range of 79.3 to 84.5 (81.5) per cent in 14 populations from the west (Europe and Iran), and 81.7 to 87.5 (84.9) in 12 populations from the east (Afghanistan and India), with an average of 83.14 for the 26 populations. But in the four populations from Turkestan the tail index is 100.5 to 103.6 (101.5). In one population from Dzungaria in the British Museum measured by Delacour the tail index in four males was 102 to 105 (103.7), and in the Turkestan populations in table 3 the two populations measured by Laubmann had an average tail index of 102.8 and 107.3, and in one measured by Zarudny and Bilkevitch the average tail index is 112.4 as against 88.0 for the population from Iran.

As the tail index of the Turkestan populations is proportionately 25 per cent greater than in the western populations (28 per cent, according to Zarudny and Bilkevitch), and 20 per cent greater than in the eastern populations, these differences in proportions do seem important.

VARIATIONS IN PIGMENTATION: Except for occasional minor details, the pattern of the pigmentation remains the same, but the

coloration is more variable than either proportion or size, and racial discrimination is based very largely on the presence or absence of the yellow lipochrome, the greater or lesser degree of saturation, and the slight differences in the distribution of pigment.

In the region where the 14 races occur, there is an obvious division between the western races, in which the plumage of the adult is pigmented with yellow above and below, and those from farther east, in which the yellow lipochrome is completely absent in the adult form and is present or absent in the immature. In this region the race (*intermedius*) that intervenes geographically between the yellow and gray races is a hybrid population, the adult showing a varying amount of yellow on the back but none on the under surface. In the races of the Far East that are not part of this study, the race (*commixtus*) intervening geographically between the gray races of India and Burma and the green-backed populations of northern China also has a varying amount of yellow lipochrome on the back.

In the yellow western races the variation affects the amount of yellow lipochrome on the lower surface of the body. In the gray eastern races the plumage above and below is saturated to a greater or lesser degree, and the greater coverts and inner tail feathers are invaded to a varying degree by melanin. The variation also affects the presence, absence, or amount of pigment on the second outer pair of tail feathers, and sometimes on the tip of the third.

Generally speaking, the degree of saturation appears to be correlated with humidity. For instance, *mahrattarum* from the wet Nilgiris, Travancore, and the mountains of Ceylon is considerably darker than are the populations from the more arid sections of northern, western, and central India. However, in dry Afghanistan, *decolorans* in some parts of its plumage is as dark as, or darker than, the heavily saturated *mahrattarum*.

RECOGNIZED RACES

Parus major major Linnaeus, 1758

TYPE LOCALITY: Sweden.

SYNONYMS: *Parus major scytharum* Floericke, 1920; type locality, Sarepta, southeastern Russia. *Parus major caucasicus* Domanevski, 1933; type locality, Lagodekhi, Transcaucasia.

These two names have been synonymized with nominate *major* by Dementiev (1935, L'Oiseau, p. 71). In my material, speci-

TABLE 3

MEASUREMENTS OF FULLY ADULT MALES IN SOME RACES OF *Parus major*
(The tail index, expressed in per cent, is the proportion of the length of the tail to that of the wing)

Race, Locality, or Region	N	Wing	N	Tail	N	Tail Index	N	Bill from Skull
<i>P. m. major</i>								
Sweden, Norway	5	75.0-78.0 (76.5)	5	60.0-65.0 (62.0)	5	77.0-87.0 (81.0)	5	12.0-14.0 (13.0)
East Prussia	7	74.0-78.5 (76.1)	7	59.0-67.0 (62.6)	7	77.5-86.0 (82.0)	7	12.0-14.0 (13.2)
Hesse	5	75.0-79.0 (76.4)	5	59.0-64.0 (61.6)	5	75.0-83.0 (79.5)	5	12.5-13.5 (13.1)
W. Russia (Pskov)	5	75.5-80.0 (77.1)	4	61.0-62.5 (62.0)	4	76.0-82.0 (79.6)	5	13.0-14.0 (13.5)
E. Russia (Orenburg)	12	76.0-82.0 (78.1)	12	59.0-68.0 (63.9)	12	76.0-87.0 (82.0)	12	12.5-14.0 (13.2)
Siberia (Altai)	4 ^a	74.0-78.0 (76.2)	4	62.0-66.0 (64.0)	4	79.0-86.5 (82.9)	4	12.5-13.5 (13.0)
Azerbaijan	23	74.5-81.0 (77.5)	21	61.0-68.0 (64.4)	21	78.0-89.0 (82.6)	24	13.0-14.0 (13.5)
<i>P. m. karelini</i>								
Gilan ^b	4	70.0-72.0 (71.4)	—	—	—	—	—	—
Southern Caspian ^c	32	68.4-76.3 (72.8)	27	61.0-68.7 (64.5)	27	85.0-91.0 (88.0)	—	—
<i>P. m. blanfordi</i>								
Shahrud	4	74.0-76.5 (75.5)	4	62.0-63.0 (62.5)	4	81.0-85.0 (82.5)	3	13.0-14.0 (13.4)
Gurgan	4	73.5-78.0 (75.9)	3	60.0-64.0 (62.0)	3	81.0-82.0 (81.5)	4	12.5-14.0 (13.2)
Tehran and region	17	73.0-79.0 (74.8)	15	57.0-65.0 (61.9)	15	76.5-86.5 (81.0)	17	12.5-14.0 (13.4)
Hamadan	5	75.0-78.0 (76.2)	5	58.0-67.0 (62.0)	5	76.0-86.0 (81.5)	5	12.5-13.5 (13.0)
Kermanshah	5	73.5-77.0 (75.4)	5	59.0-61.0 (59.8)	5	77.0-82.0 (79.3)	5	13.0-14.0 (13.5)
Luristan, Bakhtiari	26	74.0-81.0 (76.8)	25	59.0-68.0 (63.6)	25	77.5-87.0 (82.3)	26	12.5-14.0 (13.3)
Isfahan	2	77.5, 79.0	2	65.0, 68.0	2	84.0, 86.0	2	13.5, 14.0
Fars	14	75.0-80.0 (77.4)	14	59.0-69.0 (64.1)	14	77.0-86.0 (81.8)	14	13.0-14.0 (13.5)

^a Unsexed adults.

^b Stresemann (1928, Jour. Ornith., vol. 76, p. 366).

^c Zarudny and Bilkevitch (1913, Messenger Ornith., pp. 24-27).

TABLE 3—Continued

Race, Locality, or Region	N	Wing	N	Tail	N	Tail Index	N	Bill from Skull
<i>P. m. intermedius</i>								
Khorasan	28	74.0-81.0 (77.0)	26	58.0-71.0 (65.0)	26	76.0-89.0 (84.5)	27	12.5-15.0 (13.7)
<i>P. m. caschmirensis</i>								
Kashmir	7	74.0-81.5 (76.4)	7	65.0-73.0 (68.1)	7	84.0-91.0 (87.5)	10	12.5-13.5 (13.1)
Northern Punjab	11	72.0-78.0 (74.6)	11	62.0-67.0 (64.3)	11	84.5-89.0 (86.8)	10	12.5-13.0 (12.8)
Type (Gilgit)	^d	74.0 — —	—	67.0 — —	—	90.5 — —	—	13.0 — —
<i>P. m. decolorans</i>								
E. Afghanistan	6	74.0-77.0 (75.7)	6	63.0-68.0 (65.0)	6	84.0-88.5 (85.9)	6	12.5-13.5 (12.8)
Type (Jalalabad)	1	77.0 — —	1	68.0 — —	1	88.0 — —	1	13.5 — —
<i>P. m. ziaratensis</i>								
So. Afghanistan	7	71.0-76.0 (74.0)	6	62.0-67.5 (65.0)	6	85.0-89.0 (87.1)	7	12.5-13.5 (13.0)
Ziarat ^e	5	73.0-77.0 —	5	62.5-71.0 —	—	— — —	—	— — —
<i>P. m. nipalensis</i>								
Lower Nepal	5	63.0-66.0 (64.8)	5	53.0-59.0 (55.8)	5	84.0-89.0 (86.5)	5	11.5-12.0 (11.8)
United Provinces	13	63.0-70.0 (66.8)	13	52.0-60.0 (56.3)	13	79.0-87.5 (84.0)	13	11.5-13.0 (12.2)
Assam (Dibrugarh)	4	63.0-65.0 (63.5)	4	54.0-55.0 (54.8)	4	83.0-87.5 (86.0)	4	11.5-12.0 (11.8)
Bengal	3	63.0-64.0 (63.5)	3	54.0-57.0 (55.6)	3	86.0-88.0 (87.0)	3	11.5-12.0 (11.8)
<i>P. m. sinuata</i>								
Surguja	4	64.0-67.0 (65.5)	2	56.0, 58.0 —	2	85.0, 87.0 —	4	11.0-12.0 (11.6)
Central Provinces	5	64.0-67.0 (65.3)	4	53.0-58.0 (55.0)	4	80.0-87.0 (82.4)	5	11.5-12.5 (11.7)
Bhopal	2	66.0, 66.5 —	2	53.0, 56.0 —	2	80.5, 85.0 —	1	12.5 — —
Sirohi	3	65.0-69.0 (67.0)	3	52.0-54.0 (53.0)	3	75.0-79.0 (77.2)	3	11.5-12.0 (11.8)
Junagadh	7	68.0-71.0 (69.5)	7	52.0-60.0 (56.3)	7	76.0-86.0 (81.7)	7	12.0-13.0 (12.4)
Type (Sanchi)	1	66.0 — —	1	53.0 — —	1	80.5 — —	1	12.0 — —

^d Unsexed adult.^e Whistler (1929, Bull. Brit. Ornith. Club, vol. 50, p. 7).

mens from Jekaterinoslav Gouvernement in southern Russia and Orenburg Gouvernement in southeastern Russia are identical with specimens of nominate *major* from Scandinavia and western Europe. No specimens from Transcaucasia were available, but my very fine and long series from neighboring Azerbaijan also does not differ in any way from European specimens of nominate *major*. Specimens from the Altaï are likewise identical.

Parus major karelini Zarudny, 1910

TYPE LOCALITY: Talych.

This race is admissible on the basis of being smaller than nominate *major* and *blanfordi*. According to Stresemann (1928, Jour. Ornith., vol. 76, p. 366) it is a little paler than nominate *major* but darker than *blanfordi*, the yellow of the under parts in *karelini* being brighter and somewhat less tinged with greenish than in nominate *major*.

I have examined only one unmistakable specimen of this race, an adult female from Resht. Its wing measurement (68 mm.) corresponds very well to the measurements of female *karelini* given by Stresemann, whose three females from Gilan had the wing 67.0–70.5 (69.2), and the measurements of Zarudny and Bilkevitch, whose 15 females from the southern Caspian had the wing 67.2–71.4 (69.7) (1913, Messenger Ornith., pp. 27–28). Female specimens of nominate *major* are larger; in my specimens, 10 from western Europe measure 72–76 (74.2), eight from Russia 73–77 (75.1), and 10 from Azerbaijan 72–76 (74.1). In its coloration, however, the female from Resht is identical with the other female specimens of nominate *major* from Europe and Azerbaijan.

The range of *karelini* is a narrow band in the lowlands of the Caspian side of the Elburz. It may extend, as Stresemann states, as far east as the watershed between Gurgan and Khorasan. But my specimens from Gurgan and vicinity are larger than the published measurements of *karelini*, and their coloration is identical with that of a series of topotypes of *blanfordi*. In the measurements given by Zarudny and Bilkevitch, five males from Astrabad (now Gurgan) had a wing length of 71.2–75.2 (73.8). In my specimens, two males from Gurgan measure 76 and 77, and the last one is still moulting and the feather is perhaps not fully grown. Another male from near-by Shahfasand measures 78, and one from Gozlu 73.5, but this last was collected on July

15 and is badly worn. The first three males, which were collected on September 28 to 30, are very fresh, and the yellow of their under parts is quite pale and identical to the equally fresh topotypes (Tehran) of *blanfordi* taken from October 3 to 21. At Tehran and vicinity, 17 males measure 73–79, and in six other populations of *blanfordi* from the Plateau and Zagros the range of variation in 56 males is 73.5–81.0.

Since the differences between *karelini* and *blanfordi* are at best only slight and specimens indistinguishable from the latter are found in the region of Gurgan it seems preferable to limit the range of typical *karelini* to Talych, Gilan, and Mazandaran.

***Parus major blanfordi* Prazák, 1894**

TYPE LOCALITY. Tehran.

SYNONYM. *Parus major zagrossiensis* Zarudny and Loudon, 1905, type locality, Zagros Mountains.

This race differs from nominate *major*, and, according to Stresemann, from *karelini*, by having the yellow of the under parts duller and paler. Above, the green of the mantle averages duller, more grayish. In size, *blanfordi* is larger than *karelini*, the range of variation in *blanfordi* being the same as in nominate *major*.

My material of this race is exceptionally rich, all parts of the range being well represented, including a long series of topotypes (Tehran and near-by Karaj) in every stage of plumage. There is a slight amount of geographical variation: specimens from the regions of Gurgan, Shahrud, Tehran, and Kazvin, which are identical, are very slightly darker than specimens from Hamadan, Kermanshah, and Qasr i Shirin in the western Zagros; these are very slightly darker than specimens from farther south in Luristan and Bakhtiari; and these in turn are very slightly darker than specimens from Isfahan and Fars; the palest birds are those from farthest east in the region of Kirman. However, although these differences can be appreciated in series, the cline is very slight. Furthermore, there is a certain amount of individual variation, and specimens that match each other can be found in all the various populations.

Zarudny and Loudon have described the birds of the Zagros as *zagrossiensis*, but the only significant character that emerges from the long and involved description is that the birds of the Zagros are paler than nominate *major*. The authors do not compare the birds of the Zagros to those of the region of Tehran (*blanfordi*),

and, as I have stated, the differences between the birds of this region and those of the Zagros are inconstant or, in series, too tenuous to warrant separation. Ticehurst (1921, Jour. Bombay Nat. Hist. Soc., vol. 28, p. 246) found that his specimens from southwestern Iran (Dizful) and Shiraz in Fars were identical with specimens from Tehran, Kazvin, and Kermanshah.

***Parus major intermedius* Zarudny, 1890**

TYPE LOCALITY: Mountains of southwestern Transcaspia [Kopet-Dagh and Achal Tekke].

SYNONYM: *Parus major jininikowi* Zarudny, 1910; type locality, Atrek River and tributaries.

This interesting race of hybrid origin is intermediate between the yellow races of the west and the gray races of the east in which this pigment is lacking in the adult form. Its range is limited to Khorasan, including the northern mountains that project into southwestern Transcaspia. The western boundary seems to be the relatively low gap west of Bujnurd, or about at longitude 57° E., though to the northwest of Bujnurd, at Marave, about one degree farther west, my specimens belong to this race. The easternmost specimen that I have seen is from Sarakhs on the Hari Rud, and the southernmost from Gesik, or about at latitude 33° N.

It is probable that the amount of yellow pigment is not constant within the various populations. For instance, in one series consisting of 10 immatures collected on August 3 to 5 at Kotaliyek-chinar, north of Bujnurd, three specimens are very yellow below and are in fact identical to immatures of *blanfordi* from the region of Gurgan, Tehran, or the Zagros; five are faintly tinged with yellow below and are identical in coloration to immatures from India taken in Kashmir, lower Nepal, Assam, and Central Provinces; the other two specimens are intermediate. Adults vary much less, they have no yellow below, and this pigment appears as a slight greenish patch on the upper part of the mantle. The amount of pigment varies but is never pronounced and sometimes is lacking. In my longest series of adults (14 specimens) taken at Meshed on October 17, 1900, by Zarudny, the pigment is well marked in one male, is present but slight in seven males and two females, very faint in one female, and lacking entirely in three males. In birds in first winter plumage, the new body feathers

on the sides of the breast are white, but in an occasional specimen these feathers are faintly tinged with yellow.

Zarudny has described as *jitnikowi* specimens from the lower and middle Atrek and tributaries. But, as Dementiev states (1925, L'Oiseau, p. 72), there is no doubt that these hybrids, probably because they came from the western part of the range, had more yellow pigment than is usual in *intermedius*.

It has always been assumed that the gray parent stock from the east was derived from Turkestan. However, judging by the present characters of the neighboring Turkestan race (*bokharensis*), this does not appear to have been the case. Rather, as my material shows, the connection is by way of Afghanistan south of the Paropamisus Range. The following evidence may be offered in support of this view:

A. The proportions, as shown by the tail index, are different in *bokharensis* and *intermedius*. In 37 adult specimens of *intermedius* of both sexes the tail index is 76–89 (83.6), whereas in 20 adults of both sexes of *bokharensis* this index is 97–115 (101.5). In *ziaratensis* from Afghanistan, however, the tail index is similar to that of *intermedius*, four adults from Herat having the tail index 80–86 (84.0), and nine from Kandahar 82.5–89.0 (86.1).

B. The general coloration of *intermedius* and *ziaratensis* is similar, but that of *bokharensis* is quite different. In the first two the back is blue gray, on the top of the central tail feathers a variable band of blackish runs along the inner side of the web, or the whole inner web is blackish, contrasting strongly with the outer web, and the sides of the breast and belly are grayish or creamy. In *bokharensis* the back is much paler, the top of the central tail feather is uniformly colored, and the sides of the breast and belly are almost pure white.

C. Immature *intermedius* is always tinged with yellow, but five immature specimens of *bokharensis* examined do not show the slightest trace of yellow. I have seen no immature specimens of *ziaratensis*, and, unfortunately, none is reported in the literature.

D. The ranges of *intermedius* and *ziaratensis* are continuous, but *bokharensis*, which is a lowland form or a bird of the lower altitudes, is cut off by the Paropamisus and the mountain ranges of northern Khorasan. In the last region, an additional barrier, the desert of the Kara Kum, separates *intermedius* from the lowlands of Bukhara.

However, some colonies of *bokharensis* occupy the oases of the

Kara Kum, and one at Tedjen comes close to the range of *intermedius*, and south of Tedjen, at Serakhs at the extreme north-eastern corner of Khorasan, the two forms apparently occur together. From this locality I have three adult specimens of *intermedius* collected on March 28, 1905, and one first winter female of *bokharensis* taken on July 24 [August 7], 1892, by Zarudny. From Germab, which, although on the northern side of the Achal Tekke, is within the range of *intermedius*, I have an adult male of *bokharensis* taken on July 15 [July 29], 1892, by Zarudny. All these specimens, which are perfectly typical of their forms, do not show the slightest evidence of intergradation. Signs of hybridization would be easy to detect, for in addition to the differences mentioned above adult and first winter *intermedius* also sharply differ from *bokharensis* in the amount of white on the two outer pairs of tail feathers. In *intermedius* there is less white on the outer pair, and on the penultimate pair the white is limited to a very small spot at the apex; sometimes this spot is lacking, but in *bokharensis* in similar state of plumage almost the whole of the feather is white.

Germab, which is a little less than 70 kilometers northeast of Bujnurd, is at an elevation of between 600 and 900 meters. This appears to be a little high for *bokharensis* and this specimen, as well as the one from Serakhs, although both were taken during the breeding season, may have been a stray. Although insufficient, these specimens nevertheless show that, at least occasionally, *intermedius* and *bokharensis* occur together or in the same regions. What is of more interest is that, when they do, the characters of the specimens suggest that apparently the two forms do not interbreed.

THE INDIAN RACES

The Indian races of *Parus major* have been carefully studied by Whistler (1932, Jour. Bombay Nat. Hist. Soc., vol. 35, pp. 518-519; 1944, Spolia Zeylanica, vol. 23, p. 129), but since then two additional races have been described by Koelz—one, *stupae*, from the very center of India, and the other, *decolorans*, from eastern Afghanistan. Since I also find that some of the characters used by Whistler are very variable, I believe that a fresh review is preferable to an attempt to make the two new races conform to the scheme proposed by Whistler in 1932.

The characters used by Whistler that I find are too variable to be used for discrimination are the width of the white edgings of the tertials and the measurements of the white wedge on the inner web of the second outer tail feathers. I am also unable to see the differences in the shape of the bill mentioned by Whistler.

Six races are found in India and in neighboring parts of Baluchistan and Afghanistan. For the sake of comparison, I have added *cinereus* of Java and neighboring islands, as those populations were, until Whistler, thought to be inseparable from the birds of northern India. Two additional races (*bokharensis* and *ferghanensis*) are also found in Afghanistan, but these races, which are found north of the Hindu Kush, form part of the Turkestan group and are not closely related to the races of the Indian group.

Although the differences between the Indian races are not always easy to express simply, these seven races, when treated as one group and compared in series, can be distinguished in adult plumage as follows

The most obvious division is on size. Three races have a short wing and four a long one. The wing length of full adults of both sexes and a statement of the range in general terms are

SMALL RACES

<i>nipalensis</i> , northern India, 31 ♂ ♀	62-69 (65 3)
<i>stupae</i> , central India, 15 ♂ ♀	63-68 (65 2)
<i>stupae</i> , western India, 15 ♂ ♀	62-71 (67 2)
<i>cinereus</i> , Java, Bali, etc., 13 ♂ ♀ (8 from Java, 5 from Bali)	63-69 (65 5)

LARGE RACES

<i>caschmirensis</i> , Kashmir, northern Punjab, 20 ♂ ♀	68-81 (75 0)
<i>decolorans</i> , eastern Afghanistan, 10 ♂ ♀	71-77 (74 0)
<i>szaratsensis</i> , north Baluchistan, south Afghanistan, 16 ♂ ♀	67-76 (71 5)
<i>mahrattarum</i> , extreme southern India, Ceylon, 13 ♂ ♀	69-75 (72 8)

In the small races, *stupae* is slightly whiter below than *nipalensis* or *cinereus*, but the only clear-cut and constant difference is in the amount of white on the outer web of the second outer pair of rectrices. In all the true specimens of *stupae* examined there is no black at all on the outer web, whereas in all the specimens of *nipalensis* the outer web is fringed with black, and in all the specimens of *cinereus* the whole outer web, except at the very tip, is all black.

Other but less constant differences are in *stupae* the top of the tail is distinctly darker, mostly blackish; in *cinereus* and *nipalensis* it is lighter, mostly grayish. In *cinereus* the center of the greater

coverts is mostly blackish; in *nipalensis* the blue fringes of the coverts are wider and the centers paler so that the coverts appear mostly bluish; *stupae* is variable, some specimens have the coverts indistinguishable from *nipalensis*, but in most of them they are almost as dark as in *cinereus*. The white edgings of the tertials and the white wedge on the inner web of the second outer tail feathers are very variable; in *cinereus*, however, this wedge is always small, but from a third to a half of the specimens of *stupae* and *nipalensis* have this wedge just as small.

In the four large races the only constant separation is on the basis of general coloration. *P. m. mahrattarum* is distinctly darker above than any of the large or small races, the tertials and top of the tail being blackish, the white edgings of the tertials narrowest, only a narrow fringe of gray persisting on the outer web of the central tail feathers. The greater coverts are blackish as in *cinereus*, but of course *cinereus* is smaller and the top of its tail mostly grayish. The mantle of *mahrattarum* is darker, more bluish, than in *caschmirensis*, *decolorans*, and *ziaratensis*. Of the last three, *ziaratensis* is the palest, paler above and whiter below than any of the other six races. *P. m. caschmirensis* is a little larger than *ziaratensis*, slightly darker above and more saturated below. In *decolorans* the breast, sides, and especially the lower flanks are more saturated, more "smoky," than in any of the other six races, although a few specimens of *caschmirensis* from northern Punjab and some specimens of *mahrattarum* from Ceylon are almost as dark.

There is no black on the outer web of the second pair of rectrices in the specimens of *ziaratensis*, *decolorans* (one exception out of 10), and *caschmirensis* (one exception out of 20), but in *mahrattarum* a black line variable in width is present in 10 out of 11 specimens from Ceylon and southern India from the Nilgiris south. However, in five specimens from Mysore, three had no

RACE	SIZE (WING)	GENERAL COLORATION	OUTER WEB 2D OUTER RECTRIX	GREATER COVERTS	TOP OF CENTRAL RECTRIX
<i>nipalensis</i>	Small	Pale	Black line	Bluish	Mostly gray
<i>stupae</i>	Small	Pale	All white	Variable	Mostly blackish
<i>cinereus</i>	Small	Pale	All black	Blackish	Mostly gray
<i>caschmirensis</i>	Large	Pale	All white	Bluish	Mostly gray
<i>decolorans</i>	Large	Dark below	All white	Bluish	Mostly gray
<i>ziaratensis</i>	Large	Palest	All white	Bluish	Mostly gray
<i>mahrattarum</i>	Large	Darkest	Variable	Blackish	Most black

black line, and in the 10 specimens of Whistler from Ceylon (1944, *loc. cit.*), the outer web was "entirely white in five specimens and very largely black in five specimens."

A comparison in tabular form is easier to visualize, but the terms used can be only relative, for, as is obvious from the above, some of the differences are slight and tend to merge.

***Parus major caschmirensis* Hartert, 1905 (June)**

TYPE LOCALITY Gilgit, Kashmir.

Specimens from northern Punjab (Kangra, Kulu, and Lahul) average a little smaller than specimens from Gilgit, Ladak, and Baltistan, and in fresh plumage average very slightly darker and grayer on the lower abdomen and lower flanks. However, this difference is not constant, as some specimens from both populations match perfectly, and when worn all specimens are identical. Specimens from the region of Patiala City eastward to Garhwal and Kumaon are smaller than those of northern Punjab and are closer in size and coloration to *nipalensis*. In this region, *caschmirensis* and *nipalensis* probably intergrade.

***Parus major decolorans* Koelz, 1939**

TYPE LOCALITY. Jalalabad, eastern Afghanistan.

In very fresh plumage the sides of the upper breast, body, and especially lower flanks are very "smoky" and gray; with wear these parts get lighter but are still saturated. Some specimens of *caschmirensis* from northern Punjab and *mahrattarum* from Ceylon approach it, especially in fresh plumage, but are not quite so dark. The top of the tail in *decolorans* averages slightly darker than in *caschmirensis*.

The only specimens known so far are the present ones. A tentative range may be drawn as a triangle pointing towards Kabul from Kafiristan in the north to at least the Sefid Kuh on the south.

***Parus major ziaratensis* Whistler, 1929**

TYPE LOCALITY Ziarat, northern Baluchistan.

In this, the palest of the Indian races, the white edgings of the tertials appear broadest. However, this is due not to the actual width, which is very variable, but to the greater purity of the white. The white spot at the tip of the third pair of tail feathers

is equally variable, but on an average is a little larger than in *caschmirensis*. *P. m. ziaratensis* averages a little smaller than *caschmirensis*, but I cannot agree with Whistler about a difference in the size and shape of the bill.

The specimens from Herat and Kandahar are identical; although far apart these two localities have a similar climate and elevation.

***Parus major nipalensis* Hodgson, 1838**

TYPE LOCALITY: Nepal.

SYNONYM: *Parus major planorum* Hartert, 1905 (September); type locality, southern Punjab.

A small series from Dibrugarh, Assam, in the collection of the American Museum of Natural History is a little darker above and below and has distinctly less white on both webs of the second outer pair of rectrices, than specimens from farther west in lower Nepal and United Provinces.

The type of *planorum*, which is a very old specimen without date or locality, has a wing of 69 mm., a measurement which is, respectively, the upper limit of variation in my specimens of *nipalensis* and the lower limit in those of *caschmirensis*. However, since the outer web of the second outer tail feather is well fringed with black, I believe that *planorum* should be considered a synonym of *nipalensis* rather than of *caschmirensis*, in the synonymy of which Stuart Baker placed it.

Immature *nipalensis* and *stupae* can be distinguished by the same characters as those of the adult. In all (six) immature specimens of *nipalensis* from lower Nepal there is no black fringe on the outer web of the second outer tail feather, but since three out of nine immature specimens of *stupae* from Central Provinces and Surguja have a trace in two and a black fringe in one, the difference is less constant than in the adult. All the immature specimens of *stupae* have the top of the tail very distinctly darker.

***Parus major stupae* Koelz, 1939**

TYPE LOCALITY: Sanchi, Bhopal.

All the specimens of *nipalensis* that I have examined came from Patiala, the United Provinces, lower Nepal, Bengal, and Assam. In central India from about latitude 24° N. southward this race is replaced by *stupae*, the range of which extends at least as far

south as latitude 18° N., for I have a typical specimen of this race from Dumagudiem on the lower Godavari in eastern Hyderabad. The range of *stupae* probably extends farther south, for specimens examined from Mysore are intermediate between *stupae* and the larger and darker *mahrattarum*, though closer to the latter.

In the west the range of *stupae* extends to Sirohi and Junagadh, but my specimens from western India are a little larger. Three out of 10 from Junagadh and Kathiawar and one out of five from Sirohi have a slight trace of black on the outer web of the second outer pair of rectrices. This variation is too slight and the difference in measurements too small to warrant separation, particularly since in all other characters, such as general coloration, dark top of the tail, and dark greater wing coverts, the western specimens are indistinguishable from true *stupae* of central India.

***Parus major mahrattarum* Hartert, 1905**

TYPE LOCALITY: Nuwara Eliya, Ceylon.

In the avifaunal survey of Ceylon (1944, *loc. cit.*) Whistler restricts *mahrattarum* to Ceylon. However, all the specimens I have examined from Coonoor and Ootacamund in the Nilgiris, and from Travancore, are identical in all respects of size and coloration with a series from Ceylon which includes the type of *mahrattarum*. I certainly cannot see, nor could Ripley (1946, *Spolia Zeylanica*, vol. 24, p. 221), the differences in the bill and in the width of the edgings of the tertials cited by Whistler.

In 1942, Whistler (*in* Ali, Jour. Bombay Nat. Hist. Soc., vol. 43, p. 145) identified specimens from Mysore as *stupae*. Three out of six adults examined by Whistler are now in front of me; these specimens (Tumkur, Bangalore, and Mysore districts) are, as stated above, closer to *mahrattarum* but depart in being smaller and paler. It appears that the range of true *mahrattarum* comprises both Ceylon and extreme southern India, the dark and large populations reaching their northern limit in the Nilgiris; in the more arid region of Mysore to the northeast they apparently gradually merge into *stupae*.

THE TURKESTAN RACES

The tangled nomenclature and range of the Turkestan races have been well straightened out by Laubmann (1913, *Verhandl. Ornith. Gesellsch. Bayern*, vol. 11, pp. 269–275) who recognizes

four races: *bokharensis*, *ferghanensis*, *iliensis*, and *turkestanicus*.

These long-tailed and very pale races form a compact group well differentiated from the other races of *Parus major* by the important difference in proportions discussed above.

This difference is difficult to assess. The Turkestan races are almost completely isolated from the other races of *Parus major*, and the long tail may have developed as a result of their isolation, or it is also possible that the Turkestan races constitute a separate species. It may be recalled that Zarudny and Bilkevitch had originally treated them as such under the name *bokharensis* (1912, *Messenger Ornith.*, pp. 132-150).

The two specimens of *bokharensis* mentioned in the discussion of *intermedius* were found during the breeding season within the range of the latter. They show no signs of intergradation or hybridization whatever. At the other end of the range, Delacour has examined in the British Museum typical specimens of *turkestanicus* from the Urungu River in northern Dzungaria, and from near-by Altaï I have specimens of nominate *major*. These two forms are so different that signs of intergradation would be evident at once.

On the other hand, in the Pamirs, where the range of the local Turkestan race (*ferghanensis*) may be continuous with that of *P. m. caschmirensis*, occasional subadult specimens occur (two out of eight in those examined) in which there are very slight traces of yellow on the mantle. Zarudny and Bilkevitch (*loc. cit.*) also state that in Ferghana immatures can be tinged with yellow. In the other Turkestan races apparently the young are always without yellow. It is also to be noted that of the four Turkestan races, *ferghanensis* is the darkest, and in that sense comes closest to the other races of *Parus major*, although the characteristic difference in tail index still holds.

It may be that we are dealing with a group of races which, although not completely reproductively isolated in one part of their range, behave in other parts as a separate species. Additional collecting is necessary in the areas where the range of the Turkestan races comes in contact with, or closest to, that of *Parus major*, such as Transcaspia, the Pamirs, and the region between the Ala Tau and Tarbagataï to the Altaï. Until then, and in view of the fact that the Turkestan races are on the whole geographical representatives of *Parus major*, it is best to consider them as conspecific.

***Parus major bokharensis* Lichtenstein, 1823**

TYPE LOCALITY Bukhara

SYNONYM *Parus major meinertzhageni* Koelz, 1939, type locality, Balkh, Afghan Turkestan

This race is the smallest and the palest above of the four Turkestan races.

Koelz has separated the birds of Afghan Turkestan as *meinertzhageni* on the basis that in his specimens taken at Tashkurghan and Balkh in 1937 "the back lacks the sandy cast, is bluer; the wing bar is duller and the black of the throat is deeper" than in the specimens of *bokharensis* in the Rothschild Collection. I have examined the same material and five additional topotypes and two specimens from Tukzar collected by Koelz in 1939. I cannot see any difference in the coloration of the wing bar and throat, and, as regards the coloration of the mantle, the difference is very obviously due to the age of the specimens of *bokharensis* used for comparison. As Dementiev and Heptner have shown (1932, *Alauda*, p. 285), in titmice with pale bluish gray backs, the color of the mantle becomes duller in old specimens and takes on a "slight brownish tint" (i.e., "sandy"). The specimens of *bokharensis* in the Rothschild Collection illustrate this foxing very well. Specimens taken in 1892 are duller and more "sandy," and a specimen without date but much fresher has the color of the mantle "bluer" and is absolutely identical with the type and topotypes of "*meinertzhageni*." Care must be taken also not to mix the sexes. In *bokharensis*, as in *Parus cyanus* with a similar pale bluish gray mantle, females are duller and less bluish.

As mentioned by Koelz, the top of the two central rectrices is nearly entirely blue gray in the specimens from Afghan Turkestan. In this character, these birds are identical with *bokharensis*, and their measurements and tail indices are identical or similar (table 3). It may be added, with Meinertzhagen (1938, *Ibis*, p. 494), that no faunal or climatic barrier of any kind separates the plains and lowlands north of the Hindu Kush from those of Turkestan.

The specimens from Tukzar are identical with the specimens from Balkh and Bukhara. Tukzar appears to be at an elevation of between 3000 and 4000 feet. At Haibak, at an elevation of 3000 feet, Meinertzhagen (*ibid.*, p. 673) collected typical specimens of *bokharensis*. As mentioned under *intermedius*, I have seen a specimen of *bokharensis* from Germab in Transcaspia, the elevation of which appears to be between 600 and 900 meters. Al-

though preëminently a lowland form, these specimens show that *bokharensis* occasionally ascends part way up on the mountain slopes.

***Parus major ferghanensis* Buturlin, 1912**

TYPE LOCALITY: Kurschab Valley, Alaï Range, Ferghana.

This race, a highland form, differs from *bokharensis* by being slightly larger and darker, a little bluer on the mantle and distinctly more grayish on the flanks.

The specimens taken by Koelz in northeastern Afghanistan north of the Hindu Kush at Rustak and region are similar in coloration to specimens of *ferghanensis* examined from the upper Amu Daria, Kabadian, and from Margelan and Kokan in Ferghana. The birds of Rustak are a little larger, but the tail index is similar (101.3 in the birds of Rustak and 100 in the others).

***Parus major iliensis* Zarudny and Bilkevitch, 1912**

TYPE LOCALITY: Djarkent.

This race is very similar in coloration to *bokharensis* but differs from it by being larger and by having a heavier bill; *ferghanensis* is darker, especially on the flanks.

***Parus major turkestanicus* Zarudny and Loudon, 1905**

TYPE LOCALITY: Orchu River, Dzungaria.

"Just like *iliensis* in color but larger and with a distinctly longer and heavier bill."

No specimens of *turkestanicus* were available to me or to Laubmann, and this description is supplied by Delacour who had the great kindness to examine for me the specimens in the British Museum. These specimens consist of four adult males, two from southern Dzungaria collected at Manass and along the Manass River by Carruthers, and the other two collected on the Urungu River in northern Dzungaria by Przewalsky. They were reported upon by Kinnear, who found them to be "similar in colour but with larger bills and wings than specimens of *P. m. bokharensis*" from the Amu and Syr Daria (1933, in Ludlow and Kinnear, Ibis, p. 449).

MOULT

A complete post-nuptial moult in adults takes place in middle summer and early fall. In my specimens from Iran, this moult

is at its height from about July 15 to the end of August. By the middle of September this moult is generally finished, most of the specimens being in very fresh plumage, some still showing a few last traces of moult in the body plumage. An occasional specimen is lagging, such as an adult male from Gurgan in which the moult is only about two-thirds finished by September 30. Specimens from Afghanistan north of the Hindu Kush (regions of Balkh and Rustak), from Kashmir, and United Provinces are at the same stage of moult at approximately the same dates as the birds from Iran. In southern Afghanistan, however, and in central India, the moult is taking place a little later. In some specimens of *ziaratensis* taken at Kandahar and Herat from October 20 to November 13 the moult is far advanced but not quite finished, and specimens of *stupae* from central India are still moulting by the middle of October.

Juvenal specimens acquire the first winter plumage through a partial post-juvenal moult taking place during the same months as the complete moult of the adults. This moult is peculiar. Not only are all of the body feathers and coverts changed, but also the tail in part or as a whole, some of the inner secondaries, and in one case the inner primaries as well. The tail moult is most irregular. Out of 26 specimens of both sexes moulting into first winter plumage in which the tail is moulting, eight are moulting only the central pair of tail feathers, and 18 are moulting the outer pairs or the entire tail. In Whistler's juvenal specimens from central India (1939, Jour. Bombay Nat. Hist. Soc., vol. 41, p. 85) the post-juvenal moult has not yet started by August 24 to September 10.

***Parus major major* Linnaeus**

IRAN: Azerbaijan: Tabriz, October 25-31, 1940, 7 ad. ♂, 1 unsexed ad.; Ardebil, November 2-3, 4 ad. ♂, 1 ad. ♀, Namin, November 6, 1 ad. ♂, 1 ad. ♀, 1 unsexed subad.; Sarab, November 8, 4 ad. ♂, 1 subad. ♀; Livan, November 14, 1 ad. ♀; Maraghe, November 27, 4 ad. ♂, 1 subad. ♂, 2 ad. ♀; Saujbulagh, December 3-4, 1 ad. ♂, 1 ad. ♀; Rezaieh, December 6-7, 1 ad. ♂, 4 ad. ♀; Khoi, December 10, 1 ad. ♂.

***Parus major blanfordi* Prazák**

IRAN: Northeastern Iran: Shahrud, September 26-27, 1940, 4 ad. ♂, 2 subad. ♂, 1 ad. [♀], 2 subad. ♀. Mazenderan, region of Gurgan; Gozlu, July 15-16, 1 ad. ♂, 2 imm. ♂, 1 imm. ♀; Dimalu, July 16-23, 4 imm. ♂; Karimserai, July 21, 2 imm. ♂, 1 imm. ♀; Garmabdasht, July 24, 1 imm. ♂; Kherat, July 24-26, 1 ad. ♀, 1 imm. ♀, Shahfasand, September 28, 1 ad. [♂], Gurgan,

September 30, 2 ad. ♂, 1 ad. ♀. Northern Iran: Tehran, June 14-27, 1 ad. ♂, 1 imm. ♂, 2 ad. ♀, 1 subad. ♀, October 3-21, 4 ad. ♂, 1 ad. ♀, 1 subad. ♀, 1 unsexed ad.; Karaj, January 2-February 15, 1945, 2 ad. ♂, 2 ad. ♀, October 15-30, 1 ad. ♂, 1 unsexed ad.; November 14-15, 1 ad. ♂, 1 ad. ♀, November 16-December 28, 1944, 4 ad. ♂, 1 ad. ♀; Sharifabad, October 22, 1940, 1 ad. ♂, 1 ad. ♀, 1 ad. ♀?; Kazvin, October 23, 2 ad. ♂, 1 ad. ♀, 1 subad. ♀. Western Iran: Hamadan, December 20-21, 5 ad. ♂, 2 ad. ♀. Kermanshah: Qasr i Shirin, December 28-January 3, 1941, 3 ad. ♂, 5 ad. ♀, 1 subad. ♀; Kermanshah, January 14, 2 ad. ♂, 1 ad. ♀. Khuzistan: Dizful, April 23, 1940, 1 imm. ♂, 1 imm. ♀. Luristan: Burujird, January 20, 1941, 1 subad. ♂; Chamchid, February 22, 1 ad. ♂; Kalvar, May 27-29, 1 imm. ♂, 3 subad. ♀; Durud, October 19, 1 ad. ♂. Bakhtiari: Baraftab, January 30, 1 ad. ♂, Ti, February 2-10, 10 ad. ♂, 3 ad. ♀, May 31, 1940, 1 imm. ♂; Imarat, February 15-19, 1941, 5 ad. ♂, 4 ad. ♀, 1 subad. ♀; Talimausur, April 28, 1940, 1 ad. ♂, 1 imm. ♂, 1 imm. ♀; Damavar, May 4-6, 4 ad. ♂, 1 ad. ♀; Pashmshurun, May 9-April 30, 3 ad. ♂. Isfahan: Isfahan, March 3-4, 2 ad. ♂, 3 ad. ♀, 2 subad. ♀. Fars: Eglit, March 7-8, 2 ad. ♂, 1 ad. ♀, 2 subad. ♀; Shiraz, March 13-15, 2 ad. ♂, 1 ad. ♀; Niriz, March 28-30, 2 ad. ♂, 1 subad. ♂, 3 ad. ♀; Dastarjin, April 8-9, 1 ad. ♂, 1 ad. ♀; Kazerun, April 11, 1 ad. ♀, 1 imm. ♀. Southern Iran: Dehibakri, January 28-30, 1 ad. [♀], 1 subad. ♀; Gudar Ushтуру, January 30, 1 ad. ♂; Cheshmaedazi, February 1, 1 ad. ♂. Kirman: Guragan, February 10-11, 1 subad. ♂, 3 subad. ♀; Maskun, February 11-13, 3 ad. ♂, 1 subad. ♂, 2 ad. ♀.

Parus major intermedius Zarudny

IRAN: Khorasan: Marave, July 31, 1940, 2 imm. ♂, 3 imm. ♀; Bujnurd, August 2, 4 imm. ♂, 1 imm. ♀; Kotaliyekchinar, August 3-5, 5 imm. ♂, 3 imm. ♀, 2 unsexed imm.; Karak, August 7, 1 ad. ♂, 1 ad. ♀; Abdullabad, August 15, 1 ad. ♀; Bardu, August 16-21, 1 ad. ♀, 1 subad. ♀, 1 unsexed subad.; Turbat i Haidari, September 10-13, 6 ad. ♂, 1 ad. ♀, 4 subad. ♀; Nishabur, September 20-21, 2 ad. ♀; Sabzawar, September 23-24, 2 ad. ♂, 1 ad. [♂], 1 subad. ♂.

Parus major caschmirensis Hartert

INDIA: Northern Punjab, Kangra: Bhadwar, March 27, 1933, 1 ad. ♂; Baijnath, May 22, 1936, 1 ad. ♂. Northern Punjab, Lahul: Tirting, June 20, 1 ad. ♂, October 18, 1 ad. ♂; Shansha, June 30, 1 ad. ♀, October 17, 1 ad. ♂; Jalma, October 18, 1 ad. ♂; Tirot, October 22, 1 ad. ♂. Northern Punjab, Kulu: Jagatsuk, October 27, 1 ad. ♂; Bandrol, October 28, 1 ad. ♀; Kulu, October 28-November 1, 2 ad. ♂. Kashmir: 7000 feet above Bandipur, July 30, 1 ad. ♂. Kashmir, Baltistan: Skardo, August 12-16, 2 ad. ♂, 6 imm. ♂, 1 ad. ♀, 1 subad. ♀, 3 imm. ♀; Dagoni, August 24, 1 imm. ♀; Kapalu, August 27, 1 ad. ♂, 2 subad. ♀, 1 imm. ♀; Hundi, September 7, 1 ad. ♂; Hundar, September 10, 1 subad. ♂, 2 subad. ♀; Karzong Nulla, September 12, 1 ad. ♀; Karsa, September 12, 1 ad. ♀, 1 unsexed subad. Kashmir, Ladak: Leh, September 16-18, 1 ad. ♂, 1 imm. ♂, 1 ad. ♀; Pitug, September 19, 1 subad. ♂, 1 imm. ♂; She, September 23, 1 ad. ♂.

Parus major decolorans Koelz

AFGHANISTAN: Eastern: Daulatshah, June 1, 1937, 1 ad. ♂, 1 ad. ♀; Paitak, June 4, 1 ad. ♂, 1 ad. ♀; Jalalabad, December 18, 1 ad. ♂ (the type of *P. m. decolorans*), 1 ad. ♀, December 19, 3 ad. ♂, 1 ad. ♀.

Parus major ziaratensis Whistler

AFGHANISTAN: Southern: Kandahar, October 17–22, 1937, 5 ad. ♂, 5 ad. ♀; Herat, November 12–13, 2 ad. ♂, 3 ad. ♀, 1 subad. ♀.

Parus major nipalensis Hodgson

INDIA: Patiala: Patiala City, January 21, 1948, 1 ad. ♀. Garhwal: Garur, May 25, 1 unsexed imm. Kumaon: Kathgodam, April 6–7, 1 ad. ♂, 1 ad. ♀, August 20, 1 ad. ♂; Askot, August 2, 1 ad. ♂, 1 unsexed imm.; Berinag, August 6, 1 ad. ♀; Barichina, August 10, 1 imm. ♂; Lechiwala, August 31–September 3, 1 ad. ♂, 1 subad. ♂. Nepal: Simra, March 4–5, 1947, 3 ad. ♂, 1 ad. [♂]; Hitaura, May 11–June 18, 1 ad. ♂, 1 ad. [♂], 3 imm. ♂, 1 ad. ♀, 2 imm. ♀, 1 unsexed imm. Eastern United Provinces: Gorakhpur, January 28, 2 ad. ♂, 1 ad. ♀; Siswa Bazar, January 30, 1 ad. ♂, Nichlaul, February 5–13, 2 ad. ♂, 1 ad. [♂], 1 ad. ♀; Kalnahi, February 20–21, 2 ad. ♂. Bengal: Dacca, January 12–14, 1937, 1 ad. ♂, 1 ad. [♂], 1 ad. ♀; Sevoke Forest, December 19, 1936, 1 ad. ♂.

Parus major stupae Koelz

CENTRAL INDIA: Bhopal: Sanchi, January 1, 1938, 1 ad. ♂, 1 ad. ♀, January 2, 1 ad. ♂ (the type of *P. m. stupae*), January 3, 1 ad. ♀. Central Provinces: Mandla, June 22, 1946, 1 ad. ♂; Bichhia, July 2–21, 4 ad. ♂, 1 imm. ♂; Belwani-Kisli, July 28, 1 imm. ♂; Kanha, August 19, 2 imm. ♂. Surguja: Ramanujanj, September 27–October 10, 1947, 3 ad. ♂, 1 subad. ♂, 2 imm. ♂, 1 ad. ♀, 1 subad. ♀, 1 imm. ♀, 1 unsexed ad., 1 unsexed imm.; Khuri, October 14; 1 ad. ♂; Gargori, October 20, 1 ad. ♀.

WESTERN INDIA: Southwestern Rajputana, Sirohi: Anadra, December 29–31, 1948, 3 ad. ♂, 2 ad. ♀. Kathiawar: Sihor, January 23–26, 1949, 1 ad. ♂, 2 ad. ♀. Kathiawar, Junagadh: Sasan, January 31–February 6, 1949, 4 ad. ♂, 1 ad. ♀; Jamwala, February 8, 2 ad. ♂.

Parus major mahrattarum Hartert

INDIA: Nilgiri Hills: Ootacamund, February 14–16, 1937, 3 ad. ♂, 2 ad. ♀, March 1–2, 1948, 2 ad. ♂.

Parus major bokharensis Lichtenstein

AFGHANISTAN: Afghan Turkestan: Tashkurghan, September 4, 1937, 1 ad. ♀; Tukzar, September 15, 1939, 1 ad. ♂, 1 ad. ♀; Balkh, September 18–19, 1937, 6 ad. ♂, 1 ad. ♀, 1 subad. ♀, October 30–31, 1939, 1 ad. ♂, 2 ad. [♂], 2 unsexed ad., November 28, 1937, 1 ad. ♂ (the type of *P. m. meinertzhageni*), November 28–30, 2 ad. ♂, 3 ad. ♀.

Parus major ferghanensis Buturlin

AFGHANISTAN: Northeast: Khaksari, July 9, 1937, 1 unsexed subad.; Daraim, August 10, 1 subad. ♂; Saidan, August 12, 1 unsexed subad.; Rustak, August 17-26, 3 ad. ♂, 3 subad. ♂, 2 ad. ♀, 1 subad. ♀, 1 unsexed subad.

Parus monticola monticola Vigors

INDIA: Northern Punjab, Chamba: Kukti, July 4, 1936, 1 ad. ♀; Harser, July 6, 1 unsexed imm. Northern Punjab, Lahul: Sisu, October 24, 1 ad. ♂; Gundla, October 24, 1 ad. ♂, 1 ad. ♀. Northern Punjab, Kulu: Naggur, October 28, 1 ad. ♂; 8000 feet above Bandrole, November 13, 1 ad. ♂. Northern Punjab, Kangra: Kotla, January 25-February 9, 1946, 1 ad. ♂, 1 ad. ♀. Northern Punjab, Tehri: Agora, October 9, 1948, 1 ad. ♂; Kanderala, October 18, 1 ad. ♂, 1 ad. ♀; Sarutal, October 23, 1 ad. ♂, 1 imm. ♀. Garhwal: Shotal, May 16, 1 ad. ♂. Kumaon: Girgaon, June 6, 1 ad. ♀; Gunji, July 20, 1 imm. ♂.

In this species a cline of increasing pigmentation runs from west to east on the continent. Good series show that birds from the region of Simla, northern Punjab, Garhwal, and Kumaon are paler and duller yellow below, and paler and duller green above, than birds from the region of Katmandu in Nepal, Sikkim, and Darjeeling. In turn, birds from northern Burma, Yunnan, and Szechwan are deeper and brighter yellow and darker green than the specimens from Nepal, Sikkim, and Darjeeling. Except at the two extremes the differences in pigmentation are slight.

The intermediate populations of Sikkim and eastern Nepal have been described as *lepcharum* by Meinertzhagen. This race is not recognized by Ticehurst (1935, Ibis, p. 40) and Kinnear (1937, Ibis, p. 23) who consider *lepcharum* to be indistinguishable from *monticola*. These authors may be correct in not recognizing an intermediate race, but my specimens from Nepal, Sikkim, and Darjeeling, taken as a series, cannot be referred to *monticola*. Although individual specimens are very close to or match the paler *monticola*, others are equally close to or match the darker *yunnanensis*, the large majority of the intermediate specimens, however, differing slightly but appreciably from either.

MOULT: Only one specimen, an adult male taken on October 9 at Agora, in Tehri, shows evidence of moult. The moult is virtually over except for a few last traces in the body plumage.

MEASUREMENTS: Adults only. Wing: nine males, 67-71 (68.8); four females, 63-66 (65.5). Tail: nine males, 50-55 (53.0); four females, 47-53 (50.2). Bill: eight males, 12-13 (12.5); four females, 12.5-13.0 (12.6).

***Parus monticola lepcharum* Meinertzhagen**

INDIA: Northern Bengal, Darjeeling district: Tiger Hill, December 23, 1936, 1 ad. ♂; Rangirum, December 26, 1 ad. ♂. Nepal: Chitlang, March 15, 1947, 1 ad. ♂; Thankot, March 21-26, 4 ad. ♂, 1 ad. ♀.

The specimens from Nepal are identical with the specimens from Darjeeling, and with other specimens from Sikkim in the collection of the American Museum of Natural History.

The racial characters are very poorly shown by the type of *lepcharum*, as this specimen, taken at Gangtok, is not adult. It is sexed as male and appears to be a first winter bird, as the gloss is poorly developed on the crown and lacking on the throat, the outer webs of the wing and tail feathers are dull, and the rest of the plumage lacks the full intensity of the adult coloration. It also measures smaller.

MEASUREMENTS: Wing: seven males, 66-71 (68.6); one female, 67. Tail: seven males, 50-56 (52.5); one female, 51. Bill: seven males, 12-13 (12.4); one female, 12.

MEASUREMENTS OF THE TYPE: First winter male, wing, 64.5; tail, 50; bill, 11.

PARUS XANTHOGENYS

The races of this species, with the exception of those found from Sikkim eastward (*spilonotus* and relatives), have been reviewed by Whistler and Kinneer (1932, Jour. Bombay Nat. Hist. Soc., vol. 35, pp. 519-521). These authors recognize three races: nominate *xanthogenys* Vigors (type locality, Almora, northern United Provinces) for the Himalayas up to but not including Sikkim; *aplnotus* Blyth (type locality, mountains of central India) for the central and peninsular populations down to a line extending from Poona to the Godavari Valley; and in the same paper separate as *travancoreensis* (type locality, Mynall, Travancore) the birds of the Western Ghats from southern Konkan in Bombay Presidency to the Ashambu Hills in southern Travancore. In 1939 (Proc. Biol. Soc. Washington, vol. 52, p. 63) Koelz described the birds of southern Bombay Presidency as *xanthonotus* (type locality, Londa).

Examination of the Koelz specimens (listed below) and the material in the collection of the American Museum of Natural History shows that three races are easily separable and that two of these races are separated by an intermediate population. The three easily separable races and their characters are:

1. The northern nominate *xanthogenys* in which the green and yellow parts of the plumage are brightest, the wing coverts tipped with yellow instead of white, and in which, generally speaking, the yellow eye stripe extends farther forward. Except for a slight difference in size (table 4), the Nepal populations are otherwise identical with those of Tehri and northern United Provinces.

2. The central and peninsular *aplonotus*. Specimens examined from Sirohi in Rajputana, Bhopal, Central Provinces, and Mahendra in Orissa are not separable, though the specimens from Central Provinces average perhaps very slightly duller.

3. The southern *travancoreensis*. I have only three specimens of this race (two males and one female) from the Palni Hills, but they differ markedly from the specimens of *aplonotus* from the regions mentioned above in that they are much duller, the mantle almost lacks the green and is very grayish, below the yellow on the sides of the breast and on the cheeks is very pale, and the flanks and lower abdomen are grayish olive. The female specimen, a full adult, is very gray above, and below is all gray with only a faint tinge of yellow. In the three specimens from the Palni Hills the white tips of the tail feathers are much smaller than in the specimens of *aplonotus* and nominate *xanthogenys*.

The intermediate population. The series from southern Bombay and two recently collected specimens from the Kadur (a male) and Hassan (a female) districts in Mysore are perfectly intermediate in all details of coloration in both sexes between the specimens of *travancoreensis* from the Palni Hills and those of *aplonotus*. On this basis, Whistler (1943, Jour. Bombay Nat. Hist. Soc., vol. 43, p. 34) has refused to recognize Koelz's *xanthonotus* from southern Bombay. However, this intermediate population occupies a sizable range, and the characters in the specimens I have examined are constant.

As shown in table 4, specimens from the Himalayas and central India are a little smaller than those of southern Bombay, Mysore, and Travancore, but there is a good deal of overlap.

PLUMAGE AND MOULT: The variations in the female plumage have been repeatedly discussed at great length by Whistler. The 1942 paper (Jour. Bombay Nat. Hist. Soc., vol. 43, p. 146) summarizes his findings as follows: in nominate *xanthogenys* adult male and female are alike with a black crown and a black ventral stripe; in *aplonotus* adult females have a black crown but the ventral stripe is dull olive green; in *travancoreensis* adult

TABLE 4
MEASUREMENTS IN SOME POPULATIONS OF *Parus xanthogenys*
(Fully adult specimens only)

Race and Population	N	Wing	Tail	Bill
<i>P. x. xanthogenys</i>				
Tehri and northern United Provinces	5 ♂	72-77 (74.5)	53-58 (56.0)	12.5-14.0 (13.1)
Tehri and northern United Provinces	1 ♀	74 — —	55 — —	13.0 — —
Nepal	6 ♂	70-74 (72.1)	52.56 (54.7)	12.0-13.0 (12.6)
Nepal	1 ♀	71 — —	54 — —	12.5 — —
<i>P. x. aplonotus</i>				
Central India	9 ♂	71-77 (73.5)	54-61 (57.1)	12.5-13.5 (13.2)
Central India	2 ♀	70, 71 —	54, 54 —	13.0, 13.0 —
<i>P. x. xanthonotus</i>				
Southern Bombay	6 ♂	75-80 (77.7)	57-63 (59.0)	13.0-14.0 (13.5)
Southern Bombay	3 ♀	72-74 (72.8)	53-56 (54.0)	13.0-13.5 (13.3)
Type (Londa)	♂	75 — —	59 — —	14.0 — —
Mysore	1 ♂	76 — —	57 — —	13.0 — —
Mysore	1 ♀	74 — —	57 — —	13.0 — —
<i>P. x. travancorensis</i>				
Palni Hills	2 ♂	76, 80 —	60, 61 —	13.5, 14.0 —
Palni Hills	1 ♀	75 — —	57 — —	13.5 — —

females are polymorphic, having, as stated by Whistler, three phases: phase 1 as in nominate *xanthogenys*, phase 2 as in *aplonotus*, phase 3 in which both the crown and ventral stripe are dull olive green. Although the 1942 paper announced that the question is now definitely settled, Whistler asks for verification of some of these points.

Mr. B. Biswas and I have carefully considered all the statements made by Whistler in the various papers and have checked them with the adult females and first winter specimens of both sexes collected by Koelz and those in the collection of the American Museum. The number of these specimens is insufficient. As far as they go, we agree that the plumage of adult females in nominate *xanthogenys* and *aplonotus* is as stated by Whistler and that first winter birds are like their respective adults. We have only one female of *travancorensis*. This specimen, a full adult, is like phase 3 of Whistler, having both the crown and ventral stripe grayish olive or "dull olive-green." We have not seen any

specimen like phase 1 from central, peninsular, or southern India, and believe, as suggested by Whistler, that black-throated specimens from these regions marked female were probably wrongly sexed. We have five female specimens from Londa and region. In these specimens (three adults, one first winter, and the other unsexed but apparently an adult female), all have the throat and ventral stripe dull olive green, and the color of the crown varies from pure black (Whistler's phase 2) to dusky with much olive green. In one adult the crown feathers are very broadly margined with olive green; in another and in the first winter specimen the feathers are edged with this color but less so, and the crown is blacker; in the unsexed specimen the crown is still blacker, and the greenish edges are still smaller. In an adult female from southern Mysore the feathers of the crown are almost entirely greenish, only the shafts being dusky black.

We notice in Whistler's papers that all the adult females from Travancore, Ootacamund, Nilgiris, and Coonoor are greenish on both the crown and throat. No black-crowned adult female is reported from this region, all the black-crowned females being juvenals that have not yet started their post-juvenal moult, and in the 1942 paper Whistler reports that a female in the post-juvenal moult "is replacing a dull black crown with a dull olive-green crown." While this specimen is from Mysore, it is probable that a similar moult takes place in true *travancoreensis*. Mysore and southern Bombay are in the intermediate zone, and, as we have stated, our female specimens from this zone in adult and first winter plumage have the crown varying from greenish to pure black.

In conclusion we believe that the polymorphism of adult females in true *travancoreensis* is not established. The plumage in adult females seems to be as follows:

THROAT AND CROWN COLOR IN ADULT FEMALE *Parus xanthogenys*

P. x. xanthogenys; black throat and black crown

P. x. aplonotus; greenish throat, black crown

P. x. xanthonotus; greenish throat, crown varying from greenish to pure black

P. x. travancoreensis; greenish throat and greenish crown

I have seen only three moulting specimens, but the date on which one of these specimens is moulting is odd. This specimen, a male with adult wing and tail feathers, is moulting the throat

feathers on April 16 at Bheraghat in Central Provinces. Whistler (1942, *loc. cit.*) says that the moult takes place in December-January; April 16 seems to be very late, for my two other moulting specimens (adult females) are in the last stages of their post-nuptial moult by October 18 to 22 in Tehri. Whistler states that *travancoreensis* breeds late "July to August and possibly even later"; a specimen taken on December 13 in Travancore had just finished breeding. In Nepal, Koelz collected two specimens that were breeding on March 12.

***Parus xanthogenys xanthogenys* Vigors**

NORTHERN INDIA: Tehri: Kanderala, October 18-20, 1948, 1 ad. ♂, 1 ad. ♀; Sarutal, October 22-23, 1 ad. ♂, 1 ad. ♀. Northern United Provinces: Kathgodam, April 9-10, 1 ad. ♂, 1 subad. ♂; Almora, April 20, 1 ad. ♂; Sama, June 3, 1 ad. ♂, 1 unsexed subad. Nepal: Bhimpedi, March 12, 1947, 2 ad. ♂; Thankot, March 22-April 9, 2 ad. ♂; Chitlang, April 23-24, 2 ad. ♂; Deorali [near Chisapani Garhi], April 28, 1 subad. ♂, May 2, 1 ad. ♀.

***Parus xanthogenys aplonotus* Blyth**

CENTRAL INDIA: Rajputana, Sirohi: Anadra, December 29, 1948, 1 ad. ♂; Oria, January 4-6, 1949, 2 ad. ♂, 1 subad. ♂. Bhopal: Sanchi, January 2-3, 1938, 2 ad. ♂, 1 subad. ♂, 1 ad. ♀. Central Provinces: Bheraghat, March 2-May 9, 1946, 3 ad. ♂, 1 subad. ♂, 2 subad. ♀; Belwani-Kisli, July 30-August 6, 1 subad. ♂, 1 unsexed subad.; Kanha, September 4, 1 subad. ♂. Orissa: Mahendra, January 24-25, 1937, 2 ad. ♂, 1 ad. ♀.

***Parus xanthogenys xanthonotus* Koelz**

SOUTHERN BOMBAY PRESIDENCY: Londa, January 7-8, 1938, 2 ad. ♂, January 10, 1 ad. ♂ (the type of *P. x. xanthonotus*), January 15-February 13, 1 ad. ♂, 3 ad. ♀, 1 subad. ♀; Jagalbed, February 18-March 10, 2 ad. ♂, 1 subad. ♂, 1 unsexed ad. [♀].

***Parus xanthogenys travancoreensis* Whistler and Kinnear**

SOUTHERN MADRAS PRESIDENCY: Palni Hills, Kodai Kanal, March 10-11, 1937, 2 ad. ♂, 1 ad. ♀.

PARUS RUBIDIVENTRIS

This species varies geographically throughout its range which extends from Afghanistan and Turkestan (Tian Shan and Fergana) through the Himalayas to the mountains of western China. The variations can be grouped into three types: a western type consisting of the populations of Afghanistan, Turkestan, Kashmir, and northern Punjab; an eastern type ranging from the eastern end of Nepal to western China; and a geographically

intervening type in Tehri, Garhwal, Kumaon, and most of Nepal. The eastern and western types vary within themselves, but the third type, so far as is known, does not vary.

In the western type the birds are large, slaty gray on the abdomen with the black of the throat coming far down onto the breast, the mantle is tinged with olive, and the cheeks are pure white. In the eastern type the birds are small, the abdomen is buffy gray with a slight tinge of rufous, and the black of the throat is more limited, reaching only to the upper breast, the mantle is slaty without olive, and the cheeks are buffy. The geographically intervening type is rufous on the abdomen, but its other characters are intermediate or show a combination of the characters of the eastern and western types. These variations, those of the nuchal spot, and the variations within the eastern and western types are summarized below in tabular form.

VARIATIONS IN ADULT *Parus rubidiventris*

	Western Type		Intermediate Type	Eastern Type	
	Ferghana, Afghanistan	Kashmir, northern Punjab	Tehri, Garhwal, Kumaon, Nepal?	Sikkim	Northern Kansu
Belly	Slaty gray	Slaty gray	Rufous	Buffy gray	Paler buffy gray
Throat and breast	Much black	Black	Less black	Less black	Less black
Mantle	Olive	Olive strongest	Olive weakest	Slaty (no olive)	Paler slate
Nuchal spot	With rufous	With rufous	Slightly rufous	White	White
Cheeks	White	White	White	Buffy	Buffy
Size (wing and bill)	Large	Large	Intermediate	Small	Small

The rufous-bellied form has hitherto been treated as a separate species. But as Dr. Mayr pointed out to me, this form occupies a well-defined, perfectly geographically representative range and in all characters, except the rufous belly, is intermediate or a combination of the characters of the eastern and western birds. This had been sensed by Hartert, who in 1905 (*Die Vögel der paläark-*

tischen Fauna, p. 302) had suggested that it might be an altitudinal race or possibly the young of the eastern form.

Examination of the specimens collected by Koelz and those in the collection of the American Museum of Natural History shows that the following races can be recognized.

In the western type two races: *P. rubidiventris rufonuchalis* Blyth (type locality, the mountains above Simla) for the birds of Kashmir and northern Punjab, and *P. rubidiventris blanchardi* Meinertzhagen (1938, Bull. Brit. Ornith. Club, vol. 58, p. 95; type locality, Gardez Forest, eastern Afghanistan) for the birds of Ferghana, Gilgit, and Afghanistan. In the material examined, the different populations within each respective group show no differences; but when the two groups are compared, in the birds of Kashmir and northern Punjab (Chamba, Lahul, Kulu, and Bashahr) the black of the throat does not extend so far down as in *blanchardi* and usually does not reach onto or to the abdomen, and the mantle is more strongly tinged with olive. In worn specimens the olive tinge disappears, and the color of the mantle becomes indistinguishable. Fresh specimens show much individual variation in the color of the mantle and size of the black area on the breast, but the differences, though slight, are quite discernible when the specimens are compared as a series.

Keve (1943, Anz. Akad. Wiss., Vienna, vol. 80, p. 18) has described, on a single specimen, a "new" subspecies (*parvirostris*) from Tian Shan, differing from Himalayan *rufonuchalis* by its smaller bill (11 mm.). I have no Tian Shan specimens, but from Ferghana, the birds of which are associated by Keve with his "new" race, a series of specimens do not differ in the size of the bill from topotypical specimens of *rufonuchalis* from northern Punjab (table 5).

Parus rubidiventris blanchardi was described from a lone specimen which was aberrant in that the color of its mantle was "entirely lacking the greenish wash." Up to the present the species had been known only from the eastern border of Afghanistan. The specimens taken by Koelz at the Burchao Pass in the western part of north central Afghanistan extend the western border of the range by almost 400 kilometers. No geographical variation is shown by the various Afghan populations in comparative plumage.

The rufous-bellied form is *P. rubidiventris rubidiventris* Blyth (type locality, Nepal). My westernmost population of this race

is from Tehri, and these specimens as far as the belly is concerned show no signs of intergradation with my easternmost (Bashahr) population of *P. r. rufonuchalis*. It is possible, however, that the zone of intergradation is a narrow one and that intergrades will be found. No Nepal specimens were available. The Tehri, Garhwal, and Kumaon specimens are identical.

In the eastern type two races can be recognized: *P. rubidiventris beavani* Jerdon (type locality, Mt. Tongloo, Sikkim) for all the eastern populations with the exception of those of northern Kansu which are a little paler and have been separated by Stresemann as *whistleri* (type locality, Lau hu kou, northern Kansu). Meise (1937, Jour. Ornith., vol. 85, p. 514) has also separated the birds of Szechwan as *szetschwanensis* (type locality, central Szechwan), stating that they were like the Himalayan birds but smaller; *szetschwanensis*, however, does not appear to be well founded and is, I believe, synonymous with *beavani*.

Stresemann and Meise both used the wing measurements of some Sikkim specimens supplied to Stresemann by Whistler (six males, 69–74; five females, 64.5–72.5). In the measurements given in table 5, I find, however, that in specimens I have measured, Sikkim specimens (which include two topotypes of *beavani*) are smaller than those measured by Whistler, and, further, that there is in fact no significant size difference between any of the eastern populations. Comparison of three specimens from northern Kansu with the specimens from Sikkim shows that the Kansu specimens are a little paler on the abdomen and slightly more rufous, and slightly paler above on the mantle and upper tail coverts. The three Kansu specimens were part of Stresemann's original series and include a topotype of *whistleri*.

The westernmost specimens of *beavani* that I have examined were from Sikkim, but the range extends into eastern Nepal, for Mr. Biswas kindly tells me that he has examined two specimens in the British Museum taken at Dolaka not far from the Sikkim border.

MOULT: In Afghanistan the complete post-nuptial moult of the adult starts about the middle of June and is over, except for a few last traces, by early September. In one female taken on July 4 in northern Punjab the moult is far advanced, the tail and wing being almost fully grown, but in a male taken on July 30 in Kashmir the moult had barely started. In an adult male just starting to moult on June 18 in Afghanistan the moult is starting

simultaneously with the feathers of the inner wing, wing coverts, and body plumage. The moult into first winter plumage is partial and involves only the body feathers and some coverts. This moult may take place at the same time as that of the adult, or in many cases starts later, for it is not quite finished in several specimens taken from September 23 to October 12 in Afghanistan; and in four specimens taken from July 31 to August 6 in Kashmir had not started in two specimens and was just barely starting with the feathers of the crown and throat in the other two. In first winter plumage the bird differs from the adult by having the greater wing coverts and quills browner, the crest a little shorter and less glossy, the black area below generally more restricted, and the black slightly browner, less intense, and less glossy.

Adult specimens of the rufous-bellied *P. r. rubidiventris* taken in early July in Kumaon were extremely worn but had not started to moult. The only moulting specimens of this form that I have seen were two first winter birds, female and sex unknown, and an adult male taken from October 7 to 12 in Tehri. All three showed a few last traces of moult.

***Parus rubidiventris blanchardi* Meinertzhagen**

AFGHANISTAN: Southeastern: 8000 feet, above Khudikhel, May 22, 1937, 4 ad. ♂, 1 ad. ♀; Daulatshah, May 31, 1 ad. ♀; Sirotai, June 17-19, 1 ad. ♂, 1 imm. ♂, 1 subad. ♀, 1 imm. ♀, 1 unsexed imm. Northeast: Daraim, August 9-10, 3 ad. ♂, 1 subad. ♂. North central and western: Terak, September 2-4, 1939, 4 ad. ♂, 4 subad. ♂, 4 ad. ♀, 4 subad. ♀; Safedsang, September 19-25, 6 ad. ♂, 1 ad. ♀, 1 subad. ♀, 1 unsexed subad.; Burchao Pass, October 12-15, 5 ad. ♂, 2 ad. ♀, 3 subad. ♀, 1 unsexed ad., 1 unsexed subad.

***Parus rubidiventris rufonuchalis* Blyth**

NORTHERN INDIA: Kashmir: above Bandipur, 7000 feet, July 30, 1936, 1 ad. ♂; Tarakbal, July 31, 1 imm. ♂, 1 imm. ♀; Burzil, August 6, 2 imm. ♂. Northern Punjab, Kulu: Koti, June 5, 1 ad. ♂. Northern Punjab, Lahul: Jugmor, June 10, 2 ad. ♂; Gumrang, October 18, 1 ad. ♂. Northern Punjab, Chamba: Kukti, July 3-4, 1 imm. ♂, 1 ad. ♀.

***Parus rubidiventris rubidiventris* Blyth**

NORTHERN INDIA: Tehri: Bhujeka, October 12-13, 1948, 1 ad. ♂, 2 ad. ♀, 1 subad. ♀; Diar, October 6-8, 1 ad. ♂, 1 subad. ♂, 1 subad. ♀; Jagora, October 7-8, 2 ad. ♂, 2 ad. ♀, 1 unsexed subad. Garhwal: Kurumtali, May 12, 1 ad. ♂. Kumaon: near Sumto-Rahlam Pass, June 16, 1 imm. ♂; Jimba, 2 ad. ♂, 1 imm. ♂, 1 unsexed imm.; Sumdum, July 5, 1 imm. ♀; Martali, May 5, 1 ad. ♀.

TABLE 3.—*CONTINUED*

Race and Region	N	Wing	N	Bill from Skull	N	Tail
<i>beavani</i>						
Sikkim	9 ^a	66.0-69.0 (66.9)	9	11.0-12.0 (11.4)	9	46.0-49.0 (46.9)
North Burma	3 ♂	69.0, 70.0, 71.0	3 ♂	11.0, 11.0, 11.0	3 ♂	48.0, 49.0, 51.0
North Burma	2 ♀	66.0, 67.0	2 ♀	10.5, 11.0	2 ♀	44.0, 44.0
Northwestern Yunnan	4 ♂	66.0-70.0 (68.0)	4 ♂	11.0-11.5 (11.1)	4 ♂	45.0-46.0 (45.8)
Northwestern Yunnan	1 ♀	68.0	1 ♀	12.0	1 ♀	48.0
Ta pa shan Mountains	11 ♂	62.5-68.0 (64.6)	10 ♂	11.0-11.5 (11.4)	10 ♂	42.0-46.0 (44.6)
Ta pa shan Mountains	3 ♀	62.0, 62.5, 62.5	3 ♀	11.0, 11.0, 11.0	3 ♀	43.0, 44.0, 44.0
Szechwan ^b	11 ♂	62.5-70.5 (66.5)	—	—	—	—
Szechwan ^b	8 ♀	61.5-65.0 (63.0)	—	—	—	—
<i>whistleri</i>						
Northern Kansu ^c	4 ♂	63.5-68.0 (66.2)	—	—	—	—
Northern Kansu ^c	5 ♀	61.0-67.0 (63.0)	—	—	—	—

^a Unsexed adults.

^b Kleinschmidt and Weigold (1922, Abhandl. Ber. Zool. Mus. Dresden, vol. 15, no. 3, p. 12). The individual wing measurements of these specimens used by Meise in describing *szechwanensis* are as follows: Sungpan, northern Szechwan, males, 63, 67, females, 62, 63; Waschan, near Mt. Omei, western Szechwan, males, 62.5, 65, 66, 67, 67, 68, 69, 70, females, 61.5, 62.5, 62.5, 64, 64, 65.

^c Stresemann (1937, Jour. Ornith., vol. 85, p. 514). Individual wing measurements: males, 63.5, 66.5, 67, 68, females, 61, 61, 62.5, 63, 67. Three of these specimens as measured by me have: wing, males, 65, 67, female, 64; bill, males and female, all 11; tail, males, 45, 48, female, 45.

***Parus melanolophus* Vigors**

AFGHANISTAN: 8000 feet, above Khudikhel, May 22, 1937, 2 ad. ♂, 1 ad. ♀; Sirotai, June 17-18, 4 ad. ♂, 1 imm. ♀.

NORTHERN INDIA: Kashmir: 7000 feet, above Bandipur, July 30, 1936, 1 imm. ♀; Tarakbal, August 2, 1 imm. ♂; Burzil, August 6, 1 imm. ♂, 2 imm. ♀. Northern Punjab, Chamba: Kukti, July 4, 1 ad. ♀; Harser, July 6, 1 imm. ♂. Northern Punjab, Lahul: Dartse, October 9-10, 1 subad. ♂, 1 ad. ♀. Tehri: 10,000 feet, above Luni, September 24, 1948, 1 ad. ♂; Mati, September 29-30, 1 ad. ♂, 1 imm. ♂; Jagora, October 7, 1 ad. ♂; Bhujeka, October 13-14, 2 ad. ♂, 1 subad. ♀. Garhwal: Kanai, May 18, 1 ad. ♂. Kumaon: Gunji, July 17, 1 imm. ♂; Dhakuri, April 26-27, 2 ad. ♂; Martali, May 5-6, 2 ad. ♂, 1 ad. ♀.

I lack specimens in fresh plumage from Afghanistan. Worn specimens from this region (May 22-June 18) are identical with worn specimens taken from April 26 to July 4 in Chamba, Garhwal, and northern United Provinces.

MOULT AND PLUMAGE: Only three moulting specimens have been examined. In an adult male taken on June 18 in Afghanistan a complete moult is barely starting with the inner primaries and body feathers. In Tehri an immature male is moulting into first winter plumage on September 29, and in an immature female taken on October 13 this moult is just about finished. Adults taken in this region at the end of September and early part of October are in perfectly fresh plumage. Birds in first winter plumage have the greater wing coverts and quills browner; below, the black area is a little more restricted, and the black is browner and less glossy, than in adults.

MEASUREMENTS (ADULTS ONLY): Afghanistan (worn): Wing, six males, 65-68 (66.0); one female, 64. Tail, six males, 45-48 (46.5); one female, 44. Bill, six males, 11.0-11.5 (11.2); one female, 11.0.

Chamba, Garhwal, United Provinces (worn): Wing, five males, 63-66 (64.6); two females, 62, 64. Tail, five males, 43-46 (44.0); one female, 44. Northern Punjab, Tehri (fresh): Wing, nine males, 61-67 (64.4); two females, 62, 63. Tail, nine males, 41-47 (43.7); two females, 41, 42. Bill, 14 males, 11-12 (11.5); four females, 11.0-11.5 (11.4).

***Parus dichrous kangrae* Whistler**

NORTHERN INDIA: Tehri: Jagora, October 7, 1948, 1 ad. ♂; Bhujeka, October 13, 1 ad. ♀. Garhwal: Wan, May 21, 1 ad. ♀. Kumaon: Dhakuri, April 27, 2 ad. ♂, 2 ad. ♀.

Compared to Sikkim specimens (nominate *dichrous*) in comparative plumage, the specimens of *kangrae* listed above, and another October specimen from Kulu, have the broken collar on the sides of the neck a little whiter, and the color of the chin and throat contrasts more sharply with that of the breast and abdomen. Above, the specimens of *kangrae* are slightly paler, and below are a little brighter, less brown. A series of *wellsi* from northwestern Yunnan are darker above than the specimens of nominate *dichrous* from Sikkim, slightly darker below, more grayish, and show no contrast between the throat and breast, the under parts being uniformly colored. In my specimens, the specimens of nominate *dichrous* are intermediate in saturation and distribution of pigment between those of *kangrae* and *wellsi*.

MOULT: In the October specimens, the specimen from Kulu (October 28) has completed the moult, and the two specimens from Tehri (October 7 and 13) still show a very few last traces of moult in the body plumage.

MEASUREMENTS: Wing, four males, 68–70 (69.2); four females, 65–67 (65.8). Tail, four males, 44.0–46.5 (45.0); four females, 43–46 (44.5). Bill, four males, 11.0–11.5 (11.2); four females, 11–12 (11.5).

***Melanochlora sultanea sultanea* Hodgson**

NEPAL: Hitaura, May 24, 1947, 1 ad. ♂.

Wing, 113; tail, 94; bill, 18; crest from base of bill, 45.

***Sylviparus modestus simlaensis* Baker**

INDIA: Kumaon: Duni, May 3, 1948, 1 ad. ♂.

This specimen, though extremely worn, is yellower than other worn specimens taken in Nepal at the end of April.

***Sylviparus modestus modestus* Burton**

INDIA: Nepal: Chitlang, March 15–April 27, 1947, 3 ad. ♂, 1 ad. ♀; Thangkot, March 23–April 9, 4 ad. ♂, 2 ad. ♀; Deorali [near Chisapani Garhi], April 28, 1 ad. ♀. Northern Bengal, Darjeeling district: Tiger Hill, December 23, 1936, 1 ad. ♂, 1 ad. ♀, Rangirum, December 26, 2 ad. ♂, 2 ad. ♀.

As stated by Mayr (1940, *Ibis*, p. 702), this species has been over-split, and it is quite evident, as Kinnear also concluded (1937, *Ibis*, p. 25), that coloration is affected by foxing and wear. After comparing the Koelz specimens with those in the collection of

the American Museum of Natural History, I can separate only three races, and a fourth may possibly be recognizable. They are:

1. A bright race (*simlaensis*, 1917) in the western Himalayas. I have but one fresh specimen of this race, an adult male taken on December 5, 1931, at Rampur-Bashahr in northern Punjab, but this specimen is distinctly brighter and yellower than any other specimens in comparative plumage from any other part of the range, with the exception of another single specimen, an adult male from southern Annam. This latter, although taken on April 20, 1918, is not worn, and its plumage and coloration match perfectly those of the northern Punjab specimen. The birds of southern Annam, which were described as bright and yellowish, have been named *klossi* by Delacour and Jabouille. More specimens should be compared, but judging by the present ones, *klossi* cannot be distinguished from *simlaensis*.

2. A distinctly duller and grayer race (nominate *modestus*) occurs in the eastern Himalayas. All my Sikkim specimens are old and badly foxed, and the Koelz specimens from Nepal are mostly too worn, but those less worn and particularly the six adults in fresh plumage collected from December 23 to 26, 1936, near Darjeeling, show the racial difference well.

3. A slightly darker, more saturated race (*saturation*, 1906) is found in northern Burma, Yunnan, Chin Hills, and northern Tonkin. Working with the same material, I cannot, nor could Mayr (*loc. cit.*), separate in any way two large series from northern Burma and northern Tonkin. The Tonkin series was taken from November 17 to December 12, 1929, and the Burma series, though taken later in the year, from January 16 to March 30, 1939, is in comparative plumage. I have only one specimen from Yunnan, taken on September 6, 1921, and one specimen from Mt. Victoria (topotypical *saturation*), taken on May 14, 1938. These two specimens are not separable from the Burma-Tonkin series. However, the Mt. Victoria specimen is badly worn, and as wear in this species darkens the plumage, it is possible that specimens in fresh plumage from this region might be paler than the Burma-Yunnan-Tonkin populations. Judging by the variability in this species, I do not believe that this possible variation could be distinct enough to warrant separation. But if so, the name *saturation* will be restricted to the population of the Chin Hills, and *tonkinensis* Delacour and Jabouille, 1930, is available for the

populations of northern Burma, Yunnan, and Tonkin. In the meantime it appears wiser not to separate these populations from the population of the Chin Hills.

4. A race from China (*occultus*) may possibly be separated from the populations of the Chin Hills, northern Burma, Yunnan, and Tonkin. Four specimens from China (one from western Szechwan and three from Fukien) are very slightly duller and very slightly grayer, but, as these specimens are worn, this slight difference should be confirmed by specimens in fresh plumage. *S. m. occultus* was described from western Szechwan in 1912, and in 1923 La Touche separated, not very convincingly, the birds of Fukien as *ricketti*. My four specimens may be insufficient, but, as they are identical, *ricketti* appears to be a synonym of *occultus*.

TABLE 6
MEASUREMENTS IN ADULT *Sylviparus modestus*

Race and Region	N	Wing	Tail	Bill
<i>simlaensis</i>				
Kumaon, N. Punjab	3 ♂	59.0-60.0 (59.7)	36.0-40.0 (37.7)	9.0-9.5 (9.2)
S. Annam	1 ♂	57.0 — —	36.0 — —	9.5 — —
<i>modestus</i>				
S. Nepal	7 ♂	57.0-63.0 (60.5)	35.0-41.0 (38.1)	9.0-10.0 (9.2)
S. Nepal	4 ♀	56.5-58.0 (57.0)	34.0-39.0 (36.5)	9.0-10.0 (9.2)
Darjeeling	3 ♂	58.0, 60.0, 62.0	35.0, 36.0, 40.0	9.0, 9.0, 9.5
Darjeeling	3 ♀	55.0, 56.0, 60.0	34.0, 34.0, 39.0	9.0, 9.5, 9.5
Sikkim	9 ^a	56.0-64.0 (59.3)	34.0-40.0 (37.3)	9.0-10.0 (9.4)
<i>saturation</i>				
N. Burma	7 ♂	59.0-63.0 (61.0)	38.0-41.0 (40.5)	9.0-9.5 (9.2)
N. Burma	6 ♀	56.0-60.0 (56.5)	35.0-39.0 (36.5)	9.0-9.5 (9.2)
N. Yunnan	1 ♀	58.5 — —	36.0 — —	9.0 — —
N. Tonkin	6 ♂	58.0-62.5 (60.8)	36.0-42.0 (38.5)	9.0-10.0 (9.4)
N. Tonkin	5 ♀	55.0-59.0 (57.2)	35.0-37.0 (36.5)	9.0-9.5 (9.2)
Mt. Victoria	1 ♀	57.0 — —	38.0 — —	9.5 — —
? <i>occultus</i>				
W. Szechwan	1 ♂	59.0 — —	40.0 — —	9.5 — —
Fukien	2 ♂	58.0, 58.5 —	38.0, 38.0 —	9.0, 9.0 —
Fukien	1 ♀	56.0 — —	34.0 — —	9.5 — —

^aUnsexed adults.

SUBFAMILY REMIZINAE

REMIZ PENDULINUS

The penduline tits have been fully reviewed by Hellmayr (1911, in Wytsman, *Genera avium*, pt. 18, pp. 56-60), Zarudny

(1913, *Messenger Ornith.*, pp. 46-50; 1914, *ibid.*, pp. 184-222), and Hartert (1918, *Novitates Zool.*, vol. 25, pp. 305-309); further comments have been added by Dementiev (1935, *L'Oiseau*, vol. 5, pp. 82-85). Although most of these reviews are very detailed, and three species, *R. pendulinus*, *R. coronatus*, and *R. macronyx*, are generally recognized, the relationships of the various forms are still not clear.

Adequate material, particularly from central Asia, is lacking or very insufficient, but examination of the specimens available and a study of the descriptions and published statements of range lead me to believe that we are dealing with but one single, geographically variable species, by name *pendulinus*. The ranges of the various forms are geographically representative (fig. 2), and intermediate populations exist. Dementiev (*loc. cit.*) mentions several specimens formerly described as races of *pendulinus* or *macronyx*, which upon examination turn out to be intermediate between these two forms. I have such a specimen and several others, the characters of which are intermediate between *pendulinus* and *coronatus*.

In an earlier paper, Dementiev (1934, *Proc. Eighth Internatl. Ornith. Congr.*, p. 247) emphasized not only the presence of hybrid populations in *R. pendulinus* and *R. macronyx* but also the fact that the young and eggs of these two forms have a "striking resemblance."

It may be objected that specimens identified as *pendulinus*, *coronatus*, and *macronyx* have apparently been recorded from the valley of the Syr Daria, and that *macronyx* and *pendulinus* are both listed as occurring in northern Iran, and *macronyx* and *coronatus* in Ferghana and Seistan. "However [as Dr. Mayr kindly comments], the intergrading populations between these various forms are exceedingly variable and contain specimens which might be identified as belonging to either of the neighboring forms. It is a matter of taste whether such variable intermediate populations should be called intergrades or hybrids. The breeding ranges in arid central Asia of these tits are very localized in river bottoms and swamps with willows and poplars. This has favored the evolution of strikingly different races. The fact that these races interbreed wherever they come in contact shows that they are still conspecific."

The correct identification of specimens of the hybrid populations is difficult. For instance, "*yenisseensis*" now considered by

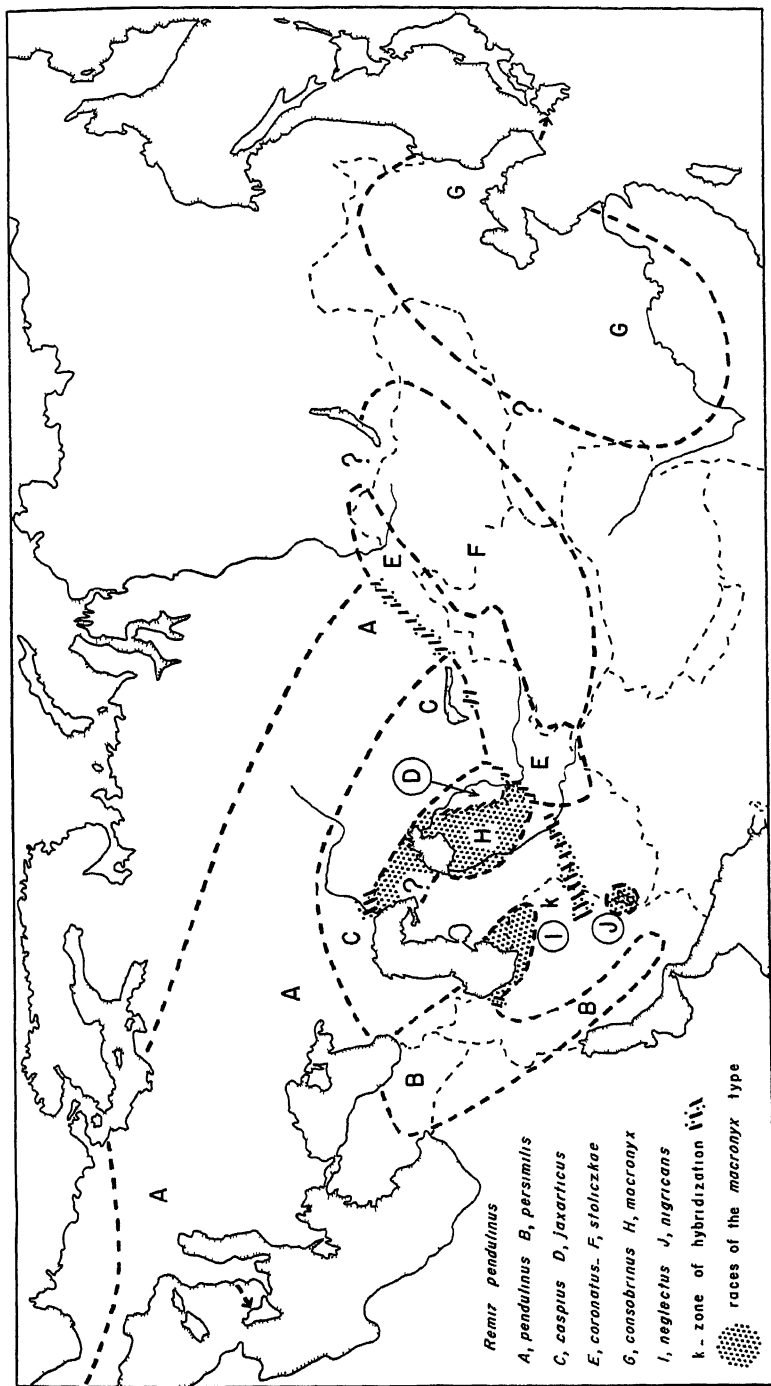


FIG. 2. Distribution of *Remiz pendulinus*; colonies breed within the indicated ranges only in suitable habitats which may be widely separated; in zone k, hybrid specimens may occur only as winter visitors.

its author Sushkin (1925, List and distribution of birds of the Russian Altaï, p. 45), to be a synonym of *coronatus*, was formerly considered by Russian authors to be a race of *pendulinus*, and an experienced worker like Hellmayr in his 1911 paper was, after the examination of the type of "*yenisseensis*," inclined to so regard it. It must not be forgotten also that these little tits, or some of their populations, are migratory, *pendulinus* and *coronatus* occurring as transients or winter visitors in the range of *macronyx*, the full wanderings starting in the late summer.

INTERMEDIATE POPULATIONS

In figure 2 some of the zones where hybridization occurs or may occur are shown by diagonal dashes and dots.

According to Dementiev (*loc. cit.*) specimens, all described as separate forms but the characters of which appear to be intermediate between those of the *macronyx* and *pendulinus* types, have been taken in the region of Lenkoran at the southwestern corner of the Caspian, the mouth of the Ural River, the middle Amu Daria, and at a locality on the southern shore of Lake Balkash.

Other probable zones are along the middle and lower Syr Daria and the region from Lake Balkash towards the upper Yenissei.

A broad zone (indicated by k in fig. 2) is shown extending from the middle Amu Daria into eastern Iran. From this zone or near it I have an adult taken on November 20 on the "Transcaspia-Persian Frontier." This specimen is intermediate between the races of the *pendulinus* and *macronyx* types, having a blackish throat and a crown that is white but without the chestnut frontal band. (For the head pattern and other characters of the various races, see table 7 and fig. 3.)

I also have an interesting series of 14 adult males from zone k which appear to be intermediate between *coronatus* and a population of the *pendulinus* type. All the 14 males lack the chestnut frontal band characteristic of the races of the *pendulinus* type, and, to a varying degree, the head pattern is intermediate between *coronatus* and the races of the *pendulinus* type. The variation is as follows:

- A. Two specimens are of the *pendulinus* type with no nuchal band
- B. Seven are identical or very similar to *coronatus*
- C. Five are more or less intermediate between A and B

These specimens were taken: one on October 20 at Maimana, three at Kang on November 2 (as these four specimens from

Afghanistan, collected by Koelz, are very close to, or identical with, *coronatus* they are identified as such in the list of the specimens collected by Koelz); two from Tedjen in Transcaspia collected on March 3 to 18 by Harms (an adult female taken at Merw at the same time is also intermediate); eight collected in eastern Iran by Zarudny from November 22 to February 26 (three of these are from southern Khorasan and the others from Persian Baluchistan)

It will be noticed that these specimens were taken, as was the *pendulinus* × *macronyx* hybrid, in fall or winter. They may all be winter visitors from farther north and east, or it is possible that isolated colonies of *coronatus* and of a race of the *pendulinus* type breed in zone k. This zone connects, more or less, the ranges of the races of the *macronyx* type (*macronyx* on the middle Amu Daria, *neglectus* in the Atrek River basin, and *migricans* in Seistan)

It may also be remarked here that the ranges shown in figure 2 are to be accepted only with reservations. They must not be taken literally; for instance, although a colony of *caspius* is reported from Lake Balkash there are apparently no records between the lake and the Ural River, and no records of nominate *pendulinus* between this river and the Semipalatinsk. Even less is known of *stoliczkae*.

CHARACTER VARIATION

The character variations in *R. pendulinus* are summarized in table 7, and the measurements are given in table 8. Reservation must be made that I had no specimens of two of these races (*macronyx* and *neglectus*) and very few in the case of others.

Remiz *pendulinus persimilis* Hartert

IRAN: Kirman. Bam, January 26, 1940, 1 unsexed subad. Luristan. Durud, March 17, 1941, 2 ad ♂, 2 ad ♀, 1 subad ♀, September 19, 1 subad ♂, October 12, 1 subad ♂, Burujird, June 19, 1 ad ♂, 1 subad ♀, 1 imm ♀, July 22–24, 1 imm ♂, 1 unsexed imm, September 21, 1 subad ♂, September 6–October 10, 1942, 2 subad ♂, 1 unsexed subad

The adults collected on March 17 and June 19 match perfectly the specimens of *persimilis* in the collection of the American Museum of Natural History which consist of the type, an adult male, taken on May 8 at Eregli, Asia Minor, and two paratypes, an adult female from Eregli collected on May 11 and an adult male collected on February 2 at Lenkoran. As stated by Hartert in the original description of *persimilis* (1918, *Novitates Zool.*, vol.

TABLE 7
CHARACTER VARIATION IN ADULT *Remiz pendulinus*

Race	Coloration of Crown	Coloration of Mantle and Upper Wing Coverts	Shape of Bill and Average Size
A ^a <i>pendulinus</i>	Whitish, a narrow chestnut band above black frontal band	Bright chestnut	Large (11.7)
B <i>persimilis</i>	As in <i>pendulinus</i> , but chestnut band exceedingly narrow	Mantle as in <i>pendulinus</i> but lesser upper coverts distinctly paler	Large (10.9)
C <i>caspicus</i>	Very broad chestnut area extending to top of crown, posterior part of crown and nape whitish	As in <i>persimilis</i>	Large (11.3)
D <i>jaxarticus</i>	As in <i>persimilis</i> , but chestnut reduced to very faint traces or lacking	A little paler than in <i>persimilis</i> and <i>caspicus</i>	Very small, short, and thin (8.5)
E <i>coronatus</i>	A black frontal band, but no frontal chestnut at all, front and top of crown whitish but posterior part and nape well marked with broad black nuchal band, with wear entire crown becomes black except for a white patch on forehead	Mantle averages paler than the above races; lesser coverts paler, more sandy	Large (11.0)
F <i>stoliczkae</i>	A black frontal band but no chestnut, crown whitish with a variable nuchal band, dusky or blackish but not true black	As in <i>coronatus</i>	Very small, short, and thin, like <i>jaxarticus</i> (8.5)
G <i>consobrinus</i>	A narrow dusky or blackish frontal band surmounted by a very narrow white band, rest of crown ashy gray with darkish shaft streaks	Mantle sandy, lesser coverts edged with sandy but with centers blackish	Short and thin (9.1)
H <i>macronyx</i> ^b	Whole crown including nape black, throat blackish	Dark chestnut	—

^a Capital letters refer to figures 2 and 3.

^b No specimens; characters taken from the literature.

TABLE 7—Continued

Race	Coloration of Crown	Coloration of Mantle and Upper Wing Coverts	Shape of Bill and Average Size
I <i>neglectus</i> ^a	—	—	—
J <i>nigricans</i>	Whole crown, nape, and upper part of mantle black, throat blackish	Upper mantle black, lower mantle and lesser coverts very dark chestnut	Slightly longer (12.4) and very pointed

^a No specimens; characters taken from the literature. Said to be like *macronyx* but smaller.

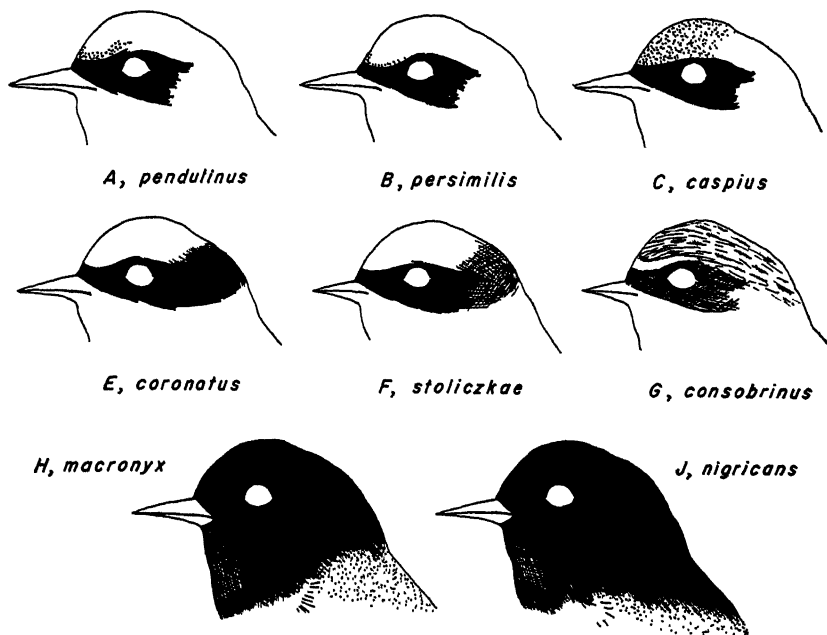


FIG. 3. Head pattern in *Remiz pendulinus*. Colors other than black as follows: white, white or whitish; hatched lines, blackish; lines (*consobrinus*), ashy gray crown with darker shaft streaks; dots, chestnut.

25, p. 307), the Koelz specimens, which are also in worn plumage, "are very much like *A. p. pendulinus*. . . the chestnut line above the black forehead is exceedingly narrow, sometimes hardly visible, top of head of male in spring pure white. Lesser upper wing-coverts and rump paler, the latter therefore in sharper contrast

to the interscapular region." The three males taken by Koelz are identical, and their wing length and that of the adult females are, with one exception, slightly shorter than in the specimens of nominate *pendulinus*.

Dementiev (*loc. cit.*) makes *persimilis* a synonym of "*menzbieri*" described in 1913 by Zarudny from the lower Karun in southwestern Iran. Despite the fact that Koelz's specimens are virtual topotypes of "*menzbieri*," I agree with Hartert that *persimilis* cannot be the same as "*menzbieri*" which was described as having a wider, not narrower, chestnut band than nominate *pendulinus*.

I do not know at what time of the year Zarudny's specimens were collected, but they might have been winter visitors of *R. p. caspius* in which the chestnut band is far broader than in nominate *pendulinus*. Or, as they evidently had more chestnut than in the latter, and, presumably, less than in *caspius*, they might have been hybrids.

Remiz pendulinus coronatus Severtzow

AFGHANISTAN: Northeast: Daraim, August 9-10, 1937, 1 ad. ♂, 2 imm. ♂, 1 unsexed imm. North central: Pul i Khumri, November 6, 1939, 1 subad. ♀. Northwest: Maimana, October 20, 1 ad. ♂, 2 subad. ♂, 4 subad. ♀. Seistan: Kang, November 2, 1937, 3 ad. ♂.

The adult male taken on August 10 at Daraim, which had probably bred locally as it is still moulting, has black head markings identical in pattern with those of two typical specimens of *coronatus* from Ferghana, an adult male and an adult female taken on May 31 and June 1. The three specimens have the basal half of the feathers of the whole crown black in the males, blackish in the female. In fresh plumage, as in the male from Daraim, the distal end of the crown feathers are whitish, except towards the nape where the black shows through as a broad nuchal band. In the two Ferghana specimens these whitish ends are mostly worn off, persisting only as a white spot on the fore crown. As stated in the discussion of the intermediate populations, the adult from Maimana and the three from Kang are identical or very close to the specimen from Daraim and the two from Ferghana.

Prior to the Koelz specimens *coronatus* was known only as a winter visitor to Afghanistan, and the only records were the two specimens collected on April 19 and 23 reported by Whistler

(1944, Jour. Bombay Nat. Hist. Soc., vol. 44, p. 516), who states also that it "is a fairly regular winter visitor to N.-W. India from Peshawar to Sind." Stuart Baker included Baluchistan within its range. Although this is questioned by Ticehurst who says he knows of no records from this region (1926, Jour. Bombay Nat. Hist. Soc., vol. 31, p. 491), I believe it probably occurs there as a winter visitor since it occurs in Sind, and I have specimens from Seistan and a January 14 specimen from Jalq just over the Iranian side of the border of southern Baluchistan.

Remiz pendulinus subspecies

IRAN: Luristan: Burujird, September 6, 1942, 1 subad. ♂.

This specimen is in first winter plumage, and, although probably a fall visitor of *neglectus*, I cannot identify it with certainty as I have not seen specimens of *neglectus* and *macronyx*, and my specimens of *nigricans* are immature or full adults. In the Burujird specimen the crown is brownish black, the pigment reaching only to the top of the crown; as adult *nigricans* is so much darker, the pigment reaching to the center of the mantle, I would expect first year *nigricans* to be darker and the pigment to reach farther back than in this specimen. The wing length, 52.5 mm., comes within the range of variation of adult *neglectus* but is too small for both *macronyx* and *nigricans* (see table 8).

MOULT AND PLUMAGE

The moult and plumages of the nominate race are described by Stresemann (1920, Avifauna Macedonica, p. 104). The only moulting specimens that I have examined are an adult male of *coronatus* taken on August 10 at Daraim in northeastern Afghanistan, in which a complete post-nuptial moult is well advanced, and two juvenal males of *persimilis* taken on September 19 and 21 in Luristan, of which one is undergoing a complete post-juvenal moult, and in the other the moult is partial, only the body plumage and central tail feathers being replaced.

After their post-juvenal moult first winter birds of both sexes resemble the general plumage of their respective adult females, but they are browner on the crown, *coronatus* being a little darker than *persimilis*. In both races the facial mask is brownish instead of blackish, and the black frontal band is lacking or faintly marked. Immatures of both races and sexes are identical before

TABLE 8

MEASUREMENTS IN ADULT *Remia pendulinus*

Race, Locality, Region, and Dates	N	Wing	Tail	Bill
<i>pendulinus</i>				
S. Europe, Feb. 12-June 28	8 ♂ 4 ♀	56.0-57.5 (57.0) 55.0-56.5 (55.9)	43.0-48.0 (46.0) 44.0-47.0 (45.2)	11.0-12.5 (12.0) 10.5-12.0 (11.4)
<i>persimilis</i>				
Type, Eregli, May 8	1 ♂	54.0	45.0	11.5
Eregli, May 11	1 ♀	52.5	38.0	10.0
Lenkoran, Feb. 2	1 ♂	53.5	42.0	11.5
Luristan, March 17, June 19	3 ♂	52.0, 52.5, 54.5	41.0, 42.5, 46.0	10.5, 10.5, 11.0
Luristan, March 17	2 ♀	53.0, 57.0	44.0, 45.0	10.5, 11.5
<i>caspus</i>				
Lower Volga, Orenburg, April 20-June 20	7 ♂ 2 ♀	55.0-59.0 (57.2) 57.0, 57.0	45.0-50.0 (46.6) 46.0, 47.0	10.0-12.0 (11.3) 11.0, 11.5
<i>jaxarticus</i>				
Perowsk, March 14	1 ♀	53.0	42.0	8.5

the post-juvenal moult, being brownish gray over the whole crown and sides of the face.

Cephalopyrus flammiceps flammiceps Burton

INDIA: Kashmir: Burzil, August 5, 1936, 1 subad. ♂. Northern Punjab, Chamba: above Kukti, July 3, 1 unsexed imm. Northern Punjab, Lahul: Puker, September 7, 1930, 1 ad. ♀. Northern Punjab, Kangra: Bhadwar, March 30, 1933, 1 ad. ♂. Northern United Provinces, Garhwal: Wan, May 14, 20, 1948, 2 ad. ♂. Northern United Provinces, Kumaon: Rahlam, June 22, 1 subad. ♂. Surguja: Gargori, October 23, 1947, 1 imm. ♂.

No specimens from the eastern Himalayas (*saturatus*) and northwestern Yunnan (*olivaceus*) are available.

Five adult males taken from March 30 to May 24 (1925–1948), in Kashmir, northern Punjab, and Garhwal are identical below in the depth and distribution of the golden orange color; above, they vary slightly, two specimens from northern Punjab being a little brighter, more yellow green, than a specimen from Kashmir and two from Garhwal. In these five specimens and in three others from the western Himalayas but without locality, the width of the red cap varies from 7 to 12 mm. The immature male from Surguja is more yellowish on the crown and below than the adult female from Lahul; this young male has no red feathers on the crown.

MOULT AND PLUMAGE: The two juvenal males taken on June 22 in Kumaon and August 5 at Burzil in Kashmir are going through a complete post-juvenal moult, the moult of the wing and tail being well advanced. The moult of the crown is about over, and the new feathers, with the exception of four or five red ones on the fore crown, are greenish. In this first winter plumage the males, in addition to the few red feathers, differ also from the adult female by being washed with weak golden orange on the throat and upper breast rather than with pale yellow.

MEASUREMENTS (ADULTS): Wing: seven males, 58–63 (60.5); one female, 64. Tail: eight males, 30–34 (31.6); one female, 35. Bill: seven males, 9–11 (9.9); one female, 9.5.

SUBFAMILY AEGITHALINAE

Aegithalos caudatus alpinus Hablizl

IRAN: Mazenderan, region of Gurgan: Garmabdasht, July 24, 1940, 3 imm. ♂; Kherat, July 27, 3 imm. ♂, 1 imm. ♀, 2 unsexed imm., September 30, 2 ad. or subad. ♂ (in this species and those following, further mention other than "imm." is omitted; see below), 1 ♀, 1 unsexed; Shahfasand, September 28, 2 ♀.

MOULT AND PLUMAGE: All the immature specimens taken from July 24 to 27 are in the midst of the post-juvenal moult. This moult is complete, the tail and wing moulting simultaneously with all the contour feathers. The September specimens are in very fresh plumage. In these, and in the very much longer series of *passekii*, I can see no difference in state of plumage other than that caused by wear. Since no juvenal feathers are retained, and the very soft plumage wears quickly and badly, no distinction appears possible on skins in this genus between adults and first winter birds. According to the "Handbook of British birds" (1938, vol. 1, p. 273), the first winter plumage in the British race is like that of the adult.

MEASUREMENTS: Wing, males, 60, 60; females, 57, 59, 59. Tail, males, 68+, 70+; females, 65+, 66+, 66+. Bill, males, 9, 9; females, 8.5, 9, 9.

Aegithalos caudatus passekii Zarudny

IRAN: Azerbaijan: Rezaieh, December 7, 1940, 5 ♂. Kermanshah: Qasr i Shirin, December 29, 1 unsexed; Surkhidizeh, January 10, 1941, 3 ♂, 1 ♀; Kermanshah, January 14, 3 ♂. Luristan: Chamchid, February 22, 1 ♂; Kalvar, May 27-29, 1940, 1 ♂, 2 imm. ♂, 1 ♀, 2 imm. ♀. Bakhtiari: Baraf-tab, January 30, 1941, 1 ♂; Ti, February 1-10, 5 ♂, 4 ♀, 1 unsexed, June 1, 1940, 1 imm. ♂; Imarat, February 15-18, 1941, 3 ♂, 4 ♀; Taze, May 2-7, 1940, 1 ♂, 1 ♀, 2 imm. ♀; Damavar, May 3-5, 2 ♂, 1 imm. ♂, 4 ♀, 1 imm. ♀. Fars: Dastarjin, April 8-9, 4 ♂, 1 ♀; Kotalipirzan, April 10, 1 ♂, 2 imm. ♀.

This long series shows no evidence of geographical variation. Specimens in comparative plumage from western Azerbaijan (December) are identical in coloration and size to the specimens from Kermanshah (December-January) and Bakhtiari (January-February). Worn specimens from Fars taken in April are indistinguishable from other worn specimens taken in May in Bakhtiari and Luristan.

These specimens fully support Paludan's observation (1938, Jour. Ornith., vol. 86, p. 605) that the birds of the mountains of western Iran are distinctly paler than those of Asia Minor (*tephronotus*) and those of the mountains along the southern Caspian (*alpinus*).

The breeding season in the Zagros begins in April or earlier. In Luristan a specimen taken on February 22 had the testes enlarged, and adults were nest building or were accompanied by fledged young on April 8 to 10 in Fars and May 3 to 7 in Bakhtiari.

No moulting specimens of *passekii* were available.

MEASUREMENTS: There is no apparent geographical variation in size: five males from western Azerbaijan have the wing, 58–62 (60.0), six from Kermanshah, 58–63 (61.0), 14 from Luristan and Bakhtiari, 59.0–62.5 (61.2), and five from Fars, 60–62 (61.1). The tip of the tail wears badly, but there is also no significant variation in length and none in that of the bill.

The combined measurements are: Wing, 30 males, 58.0–62.5 (61.0); 16 females, 56.0–62.5 (58.5). Tail, 30 males, 61–72 (67.2); 13 females, 59–71 (65.4). Bill, 30 males, 7.5–9.0 (8.6); 16 females, 8–9 (8.7).

DIAGNOSTIC CHARACTERS OF IRANIAN RACES: Comparison of the population from western Azerbaijan and the populations of the Zagros from Kermanshah to Fars with the series from the region of Gorgan (*alpinus*) and a series of eight specimens of *tephronotus* from Asia Minor in the collection of the American Museum of Natural History shows that *alpinus* is darkest, deeper gray above and brown below and that *tephronotus* is lighter than *alpinus* above and below, but still distinctly darker than *passekii*, especially below. In *passekii* the under parts are very pale, have little or no brown, and lack the fine streaking on the throat of *alpinus* and *tephronotus*; in *tephronotus* this streaking is variable but averages less than in *alpinus*. The rosy tints of the feathers of the lower flanks appear to be a little brighter in *passekii*, but this no doubt is caused by the greater contrast with the paler and whiter abdomen.

Aegithalos niveogularis Moore

INDIA: Northern Punjab, Lahul: Tsokang Nulla, October 19, 1936, 2 ♂, 1 ♀. Tehri: Tela, October 1, 1948, 1 ♀, Bhujeka, October 11–13, 5 ♂, 1 ♀. Kumaon: Dhakuri, April 28, 1 unsexed imm.

MOULT: All the October specimens are moulting. The moult is complete, and most of the specimens are in the midst of it. In an October 1 female specimen from Tehri and two males from October 19 in Lahul the moult is almost over, a few traces still persisting in the body plumage. In the October 1 specimen, the tail also is not quite fully grown.

MEASUREMENTS: The wing of these three specimens measures: males, 62, 63; female, 59. Tail: males, 56, 57. Bill in all the specimens: seven males, 10.0–10.5 (10.3); three females, all 10.

Aegithalos concinnus iredalei Baker

NORTHERN INDIA: Northern Punjab, Kulu: Banjar, January 2, 1933, 1 ♂. Kumaon: Dhakuri, April 28, 1948, 1 ♀; Khati, April 29, 1 ♀. Garhwal: Shotal, May 17, 1 ♂; Wan, May 20, 1 imm. ♂. Tehri: 10,000 feet, above Luni, September 24, 1 ♀; Kanderala, October 20, 1 ♂; Sarutal, October 23, 1 ♂. Nepal: Bhimpedi, March 13, 1947, 1 ♂; Thankot, March 21–April 14, 6 ♂, 3 ♀; Chitlang, March 15, 1 unsexed, April 19–24, 1 ♂, 2 imm. ♂, 2 ♀, 1 unsexed, 1 unsexed imm.; Deorali [near Chisapani Garhi], 1 unsexed.

I have no specimen in fresh plumage from Nepal. Worn specimens from this region (April 2–29) are identical to two equally worn specimens from Kumaon (April 28–29) and a May 17 specimen from Garhwal.

Ticehurst has separated the birds of the eastern Himalayas from Sikkim to the Mishmi Hills as *rubricapillus* on the basis of being smaller than *iredalei*, and, in fresh plumage, bluer on the back, and darker chestnut on the head and flanks. The measurements, not broken down as to sex and not averaged, are given as 46–52 in 20 birds from Sikkim, and 50–57 in 20 from the north-western Himalayas.

I have only three unsexed specimens from Sikkim, the wing lengths of which are 48, 51, 52. These measurements are insufficient and the skins are too old for color comparison. The measurements given below that I have taken and those of a series from Nepal in the British Museum measured by Biswas show that the birds decrease in size from west to east. However, the differences are so slight that it is doubtful if a series of measurements from Sikkim would show a size difference of taxonomic significance.

Individual wing measurements in *Aegithalos concinnus* in the Himalayas are as follows:

Simla: Unsexed, 52.

Northern Punjab: Males, 54, 54, 55, 55, 55, 56, 56, 57 (55.2); females, 51, 52, 52.5, 52.5, 54 (52.4).

Central Nepal: Vaurie: Males, 52, 52.5, 53, 53, 53, 54, 54, 55 (53.3). Biswas: Males, 49, 49, 50, 50, 51, 51, 51, 52, 52, 52, 52, 55 (51.2). Vaurie: Females, 49, 50, 50, 51, 52, (50.4). Biswas: Females, 49, 51, 51, 52 (50.8).

Sikkim: Unsexed, 48, 51, 52 (50.3).

In the specimens that I have measured, the tail (which is seldom perfect) measures: Simla, unsexed, 45; northern Punjab and Kumaon, eight males, 49–53 (51.8); five females, 47–52 (49.0); Nepal, eight males, 51–58 (53.0); five females, 45–50

(48.0); Sikkim, three unsexed, 46–52 (48.3). Bill: Simla, unsexed, 8.5; northern Punjab and Kumaon, eight males, 8.5–9.2 (8.9); five females, 8.0–9.5 (8.7); Nepal, eight males, 8.5–9.0 (9.0); five females, 8.5–9.0 (8.9); Sikkim, two unsexed, 8.5, 9.0.

MOULT: The three specimens taken on September 24 and October 20 to 23 are in the last stages of a complete moult. Two of these specimens appear to have been juvenals. If so, as in *A. caudatus*, no distinction is possible on plumage between adults and first winter birds.

***Aegithalos leucogenys* Moore**

AFGHANISTAN: Daulatshah, May 30–June 1, 1937, 3 ♂, 1 ♀, 2 imm. ♀, 1 unsexed imm.

These specimens in worn plumage measure in the adult: Wing, males, 56, 56, 57; female, 54. Tail, males, 51+, 52+, 55+; females, 50+. Bill, males, 10.0, 10.0, 10.5; female, 9.5.

AMERICAN MUSEUM NOVITAT¹

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THREE NEW ANTILLEAN FULGOROIDEA, WITH DISTRIBUTIONAL NOTES ON A FEW OTHERS (HOMOPTERA)

BY JOHN S. CALDWELL¹

The following records are based on a collection of West Indian fulgoroids in the American Museum of Natural History which contained for the most part material from Puerto Rico and the Virgin Islands. The types are deposited in the collection of the American Museum of Natural History. The data for the Puerto Rican material have been submitted for publication elsewhere. The miscellaneous records are presented herein:

CIXIIDAE: *Oliarus complectus* Ball; Cuba, Jamaica, Hispaniola. *Oliarus maidis* Fennah; Guadeloupe. *Microledrida* species (female); Cuba.

DELPHACIDAE: *Euidella magnistylus* (Crawford), Hispaniola. *Delphacodes propinqua* (Fieber); Cuba, Hispaniola, Dominica. *Delphacodes teapae* (Fowler); Cuba, Dominica, Guadeloupe, Martinique. *Delphacodes albonotata* (Crawford), Cuba, Guadeloupe. *Delphacodes humilis* (Van Duzee), Cuba, Jamaica, Hispaniola. *Delphacodes fulvidorsum* (Metcalf); Cuba, Guadeloupe, Martinique. *Sogata furcifera* (Horvath), Guadeloupe. *Chloriona slossonae* Ball, Hispaniola. *Kelisia contorta* Muir; Jamaica.

FLATIDAE: *Petrusa marginata* (Brunnich); Hispaniola.

Bothriocera hispaniolae, new species

Figures 3, 6

Length: Male 4.8 mm.; female 5 mm. Body, except head and pronotum, brownish black to fuscous. Head and pronotum from above brownish yellow. Face brown with lateral carinae yellowish. Forewing yellowish; stigma and apical spot in costal cell blackish; outer apical area posterior to stigma enfumed, clearish areas present in first six or seven apical cells; cross veins

¹ Circleville, Ohio.

broadly darkened, other veins mostly dark brown. Legs yellowish to piceous.

Male anal segment very broad, plate-like. Pygofer greatly produced on either lateroposterior margin. Style with off-set apical area visible in either lateral or ventral aspect. Aedeagus with one long, broad, serrate process on right and another narrow, sickle-like process on right at point of segmentation; apical portion flagellate; periandrium with a dorsoapical lobate process on left.

Male holotype, June 2-6, 1915, and female allotype, May 22-27, 1915, from Samana, Dominican Republic.

***Cubanella haitiensis*, new species**

Figures 2, 5

Length: Male 5 mm. General appearance gray to slightly testaceous. Lateral compartments of pronotum and mesonotum conspicuously darker than median tablet. Forewing grayish hyaline along basal costa, remainder darker; a black spot present at union of claval veins; veins alternate light and dark, especially apically.

Face broad, little narrowed between eyes; lateral carinae not highly elevated. Vertex with anterior compartment little longer than posterior; anterior compartment with median carina. Forewing less than two and one-half times as long as broad; media five branched. Metatibia trispinose. Male anal segment short; ventral margin sinuate in lateral aspect. Lateroposterior margin of pygofer rounded. Style elongate, acute apically. Aedeagus with apical segment bearing a prebasal process on the right as long as itself; periandrium with a pair of thick, heavy-set, caliper-like, subapical processes and one pair of slender, dorsoapical processes.

Male holotype from Port-au-Prince, Haiti, March 21-29, 1922, about 300 feet.

***Cubanella jamaicensis*, new species**

Figures 1, 4

Length: Male 8 mm. General color yellowish white marked with brown. Vertex, median tablet of pronotum and mesonotum, and the commissural margin lighter than adjacent areas, forming a median stripe. Forewing embrowned in basal half, omitting several costal spots and a streak along the commis-

sural; apical area with a brown pre-apical spot touching twice on costa; cross veins brown; stigma yellowish.

Face elongate, narrow; lateral carinae greatly elevated. Vertex with anterior compartment extremely narrow. Forewing little over twice as long as broad; media seven branched. Metatibia trisponose. Male anal segment short, not deflexed apically.



FIG. 1. *Cubanella jamaicensis*. A. Lateral of male genitalia, left. B. Ventral of style and medioventral process of male pygofer.

FIG. 2. *Cubanella hartiensis*. A. Lateral of male genitalia, left. B. Ventral of style and medioventral process of male pygofer.

FIG. 3. *Bothriocera hispaniolae*. A. Lateral of male genitalia, left. B. Ventral of style and medioventral process of male pygofer.

Lateroposterior angle of pygofer rounded. Style diagonally truncate in ventral aspect. Aedeagus with apical segment bearing a short prebasal lobe on right; perianthrium with one pair straight, elongate, subapical processes and one subapical bifid process on right.

Male holotype from Cumberland District, Clarendon, Jamaica, December 15-18, 1919, about 3000 feet.

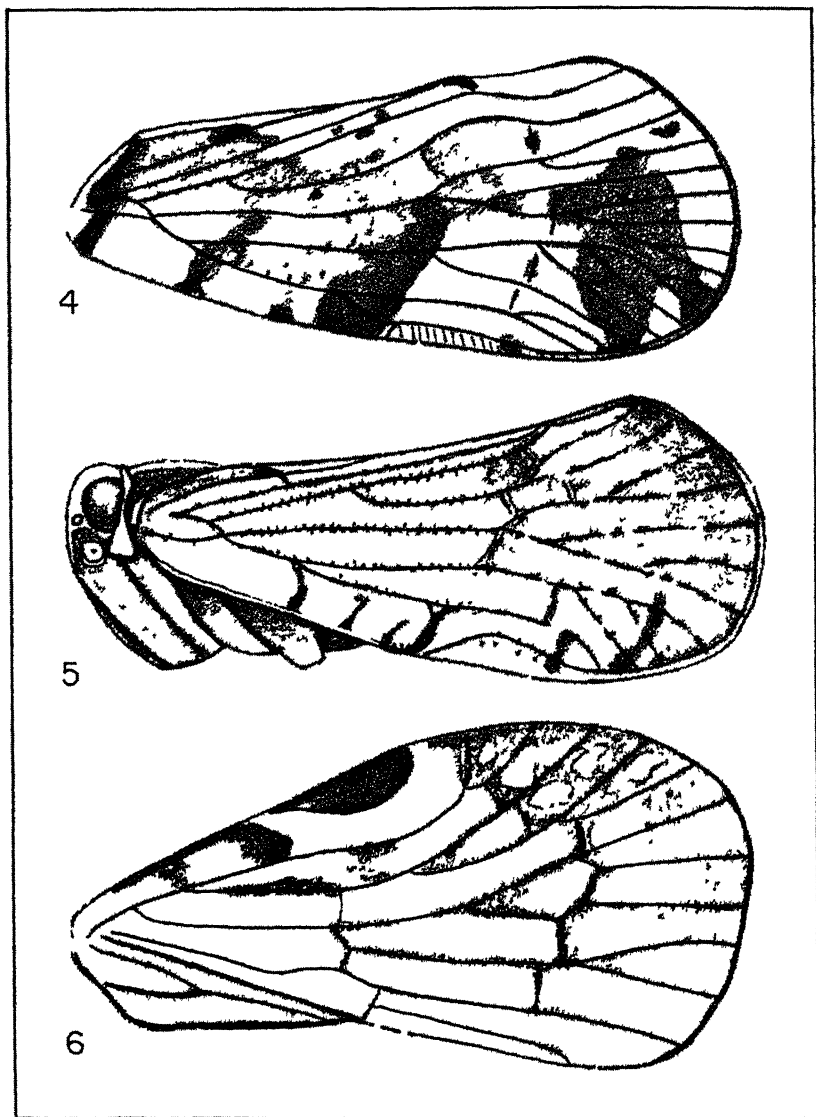


FIG. 4. Wing of *Cubanella jamaicensis*.
FIG. 5. Side view of *Cubanella hartiensis*.
FIG. 6. Wing of *Bothriocera hispaniolae*.

AMERICAN MUSEUM NOVITATES

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 63

THE CRUSTACEA DECAPODA MACRURA COLLECTED BY THE ARCHBOLD NEW GUINEA EXPEDITIONS

By L. B. HOLTHUIS¹

As was to be expected, the collection of macrurous decapod Crustacea gathered by the three Archbold expeditions (1933-1934 to southeast Papua, 1936-1937 to the Fly River region of southwest Papua, and 1938-1939 to the central mountain range of Netherlands New Guinea) is very small, since during these expeditions the emphasis was placed on the collecting of vertebrates, insects, and plants, while no special attention was given to the Crustacea. No macrurous decapods were collected at all by the first Archbold expedition, while the collections of that group made by the second and third expeditions consist of only three species (one belonging to the prawns and two to the crayfishes). All species are fresh-water forms. The number of specimens totals 33 (seven prawns and 26 crayfishes). The prawns belong to a widely distributed species, but both species of crayfish are new to science.

The material of the second Archbold expedition is preserved in the American Museum of Natural History in New York, that of the third expedition in the Zoological Museum at Buitenzorg, Java. I wish to express my sincere gratitude to Mr. John C. Armstrong, Assistant Curator of Invertebrates of the American Museum of Natural History, for the privilege of examining the material of the American Museum, and to Mr. M. A. Lieftinck,

¹ Rijksmuseum van Natuurlijke Historie, Leiden, Holland.

Director of the Zoological Museum at Buitenzorg, for allowing me to study the material of his museum.

It was my good fortune that at the time I examined the present material, Dr. L. J. Toxopeus, at present Professor of Zoology at the University of Indonesia, Bandung, Java, was visiting the Leiden Museum. Dr. Toxopeus, who was the entomologist of the Third Archbold Expedition and in that capacity collected the crayfishes of the Balim and Ibele rivers, provided me with valuable information concerning these animals.

An itinerary of the Second Archbold Expedition has been given by Rand and Brass (1940), of the third expedition by Archbold, Rand, and Brass (1942), and Toxopeus (1938-1941) has also published his impressions as an entomologist of the latter expedition.

For the photographs reproduced in this paper I am much indebted to Mr. H. C. Cornet, of the Rijksmuseum van Natuurlijke Historie at Leiden.

SUBORDER MACRURA

DIVISION NATANTIA

Only one species of prawn was collected:

Macrobrachium rosenbergii (De Man)

MATERIAL EXAMINED: Upper Fly River, 5 miles below Palmer Junction, Western Division of Papua, latitude $5^{\circ} 58' S.$, longitude $141^{\circ} 28' E.$; May, 1936; 1936-1937 Archbold New Guinea Expedition; one male specimen, *ca.* 260 mm.

Lower Fly River, opposite Sturt Island, Western Division of Papua, latitude $8^{\circ} 13' S.$, longitude $142^{\circ} 14' E.$; October 7, 1936; 1936-1937 Archbold New Guinea Expedition; six specimens (two males and four females), 85-100 mm.

The large male specimen lacks the tip of the rostrum and both second legs. Some of the smaller specimens too are damaged, but the identity of the material could be established beyond doubt.

Macrobrachium rosenbergii (De Man), which in older literature generally is named *Palaemon carcinus* Fabricius (for a discussion of the correct name of this species, see Holthuis, in press), has a rather wide range of distribution. It is known from India, Malaya, Siam, the Malay Archipelago (including the Philippines and New Guinea), and also has been found in western and northern Australia (the American Museum of Natural History possesses several specimens of this species from Archer River, Queensland).

The species lives in fresh and brackish water (very often in large rivers), and has also been recorded from the sea.

SUBORDER MACRURA

DIVISION REPTANTIA

The two species of crayfish dealt with here both belong to the parastacid genus *Cherax*. This is the only genus of Parastacidae known to inhabit New Guinea. A revision of the New Guinea crayfishes has been given recently by the present author (Holt-huis, 1949). In this revision 10 species and one variety were described and figured. Neither species collected by the Archbold expeditions can be identified with any of these published New Guinea Parastacidae, and therefore each is described here as new.

***Cherax divergens*, new species**

Figure 1

MATERIAL EXAMINED: Upper Fly River, 5 miles below Palmer Junction, Western Division of Papua, latitude 5° 58' S., longitude 141° 28' E.; May, 1936; 1936-1937 Archbold New Guinea Expedition; one male, 168 mm.

DESCRIPTION: The rostrum is slender and reaches distinctly beyond the end of the antennular peduncle and almost attains the tip of the scaphocerite. It is 3.2 times as long as its basal breadth.¹ The upper surface of the rostrum is distinctly concave, and the tip is directed straight forward. The lateral margins of the rostrum each bear two well-developed teeth, which are placed in about the middle and at three-fourths of the length of the rostrum. The broadest part of the rostrum lies a small distance behind the proximal teeth. From that point the rostrum regularly tapers towards the apex. The rostral carinae are very strong and continue a good distance on the carapace; at about one-fourth of the distance between the cervical groove and the posterior limit of the orbit they become inconspicuous and disappear. Caudally these carinae are converging slightly. The postorbital spines are strong and continue posteriorly in strong postorbital carinae which almost reach as far backward as the rostral carinae. No median carina is present. The carapace is finely pitted, each pit bearing a few short hairs. In the lateral part of the carapace behind the

¹ The basal breadth is considered here to be the distance between the rostral carinae at the level of the postorbital spines. The length of the rostrum is measured from the postorbital spines to the tip of the rostrum.



FIG. 1. *Cherax divergens*, new species, holotype. Dorsal view. $\times 0.76$.

cervical groove, small tubercular elevations are present immediately behind the pits, giving this part of the carapace a rather rough appearance. The cervical groove is very deep. Three heavy, anteriorly directed spines are placed close behind the cervical groove in the middle of each of the lateral surfaces of the carapace.

The epistome is smooth but for a short row of tubercles, which runs laterally from each anterolateral angle of the oral field. The sternal keels are sharp, and the last is evenly rounded. No perforations are visible in the lateral processes.

The abdomen is smooth, the pleurae are provided with rather numerous pits, while a few pits also may be observed on the rest of the dorsal surface of the segments. The telson is normal in shape.

The eyes have the cornea slightly broader and shorter than the eye stalk.

The antennula is normal in shape. The antenna has the scaphocerite long and slender, triangular in shape. The scaphocerite is broadest in the basal half and gradually narrows into the final tooth. It is 3.1 times as long as broad. The antennal peduncle reaches about as far forward as the rostrum. Each of the first, second, and third joints of the peduncle is provided with a well-developed sharp spine.

The third maxilliped just fails to reach the base of the last segment of the antennal peduncle.

The first legs reach, with the end of the merus, to the tip of the scaphocerite. The chela is almost four times as long as wide. The fingers are 0.8 times as long as the palm. The cutting edge bears in the middle of its length a distinct sharp tooth. Behind this tooth the edge bears six to eight smaller teeth, while before it five or six very small teeth are visible. The dactylus also bears one fairly large tooth, which is situated behind the large tooth of the fixed finger. Behind this tooth there are four or five smaller teeth, and before it eight very small teeth. Short hairs are present along both sides of the cutting edges, being most distinct in the basal part. The palm is elongate, being twice as long as broad; both margins are straight and diverge from the base. The upper margin is sharp and serrate by the presence of a single row of some 16 or 17 anteriorly directed sharp teeth. The lower margin is rounded. Both surfaces of the palm are convex; the outer is rather evenly convex, but the inner bears a median longitudinal

elevation, at both sides of which (and especially at the upper side) the surface is somewhat depressed. A large, uncalcified region is present on the lower surface of the fixed finger, extending a very small distance on the palm. This uncalcified area starts at 0.9 of the length of the palm (measured from the base) and extends all the way up to the tip of the finger. The carpus is somewhat more than half as long as the palm. Its anterior margin bears three strong spines at the inner and lower side, while a fourth spine is present in the middle of the inner surface of the carpus. The merus is about twice as long as the carpus, and somewhat less than four times as long as high. Its upper margin bears a strong spine at about one-fifth of its length from the anterior margin. Behind this spine a small tubercle is visible; the rest of the upper margin is quite smooth. The inner margin of the lower surface of the merus bears some indistinct tubercles in the basal part; the outer margin is vague but bears two or three very strong spines in the middle. The anterior margin of the merus bears one spine at the inner and one at the outer side of its lower part. The ischium is about one-third of the length of the merus and bears a strong spine at the inner margin.

The second pereopod reaches as far forward as the tip of the rostrum. The fingers are as long as the palm and two-thirds of the length of the carpus. The merus is about 1.5 times as long as the carpus. The third leg reaches with half the length of the fingers beyond the scaphocerite. The fingers are three-fourths of the length of the palm, half as long as the carpus, and two-fifths of the length of the merus.

The fourth leg just fails to reach the end of the antennular peduncle. The dactylus is 3.5 times as long as high and bears at its lower margin about 40 spinules, arranged comb-like. The propodus is 2.5 times as long as the dactylus, 1.3 times as long as the carpus, and 0.8 times as long as the merus. The fifth leg reaches slightly beyond the base of the scaphocerite. The propodus is three times as long as the dactylus and 1.75 times as long as the carpus, while it is of about the same length as the merus.

The pleopods and uropods are normal.

The species belongs to the *Astaconephrops* section of the genus *Cherax*. This section is characterized by the strong development of the rostral carinae, and its New Guinea representatives have the scaphocerite triangular in shape. *Cherax divergens* is most closely related to *Cherax albertisii* (Nobili), and it even is not im-

possible that the present specimen is nothing but an adult male of *Cherax albertisii*. The differences from *Cherax albertisii* are:

1. The rostrum bears two lateral teeth at each side only (three in *C. albertisii*).
2. The rostral carinae are somewhat more pronounced.
3. The chela of the first leg is relatively broader and has the palm differently shaped.
4. The adult male has an uncalcified area on this chela.

Though the character of the number of lateral teeth of the rostrum in my material of the *Astaconephrops* group is pretty well constant within the species, it is possible that the first character mentioned here is not of much value. The absence of an uncalcified area in the chela of the only male specimen of *Cherax albertisii* (Nobili) seen by me (a specimen of 96 mm.), may be due to the fact that this male specimen was not fully developed. Young males of other species of this group (e.g., *Cherax lorentzi* Roux) also lack this uncalcified region, but the difference in the shape of the chela is far less than between the above male of *Cherax albertisii* and the present specimen. The question whether *Cherax divergens* is based on an adult male of *Cherax albertisii* or not can be solved only by much more material than that which is at my disposal.

As were *Cherax lorentzi* and *C. albertisii*, the present species was collected at a low altitude. Rand and Brass (1940, p. 368), in their itinerary, state that the Fly River at Palmer Junction Camp, which is very close to the locality where the present specimen was collected, is only about 30 meters above sea level.

***Cherax monticola*, new species**

Figures 2-4

"Kreeften" KREMER, 1923, *Onze Vloot*, vol. 15, p. 30.

"Crayfish" ARCHBOLD, RAND, AND BRASS, 1942, *Bull. Amer. Mus. Nat. Hist.*, vol. 79, pp. 256, 268.

"een groot soort kreeften" LE ROUX, 1948, *De Bergpapoea's van Nieuw Guinea*, vol. 1, p. 317.

MATERIAL EXAMINED: Ibele River, 15 kilometers northeast of Habbema Lake, altitude 2250 meters, latitude 4° S., longitude 138° 44' E., November 26, 1938; Netherlands-American North New Guinea Expedition, 1938-1939 (i.e., the Third Archbold Expedition); four males, 102-112 mm.; nine females, 97-125 mm. (paratypes).

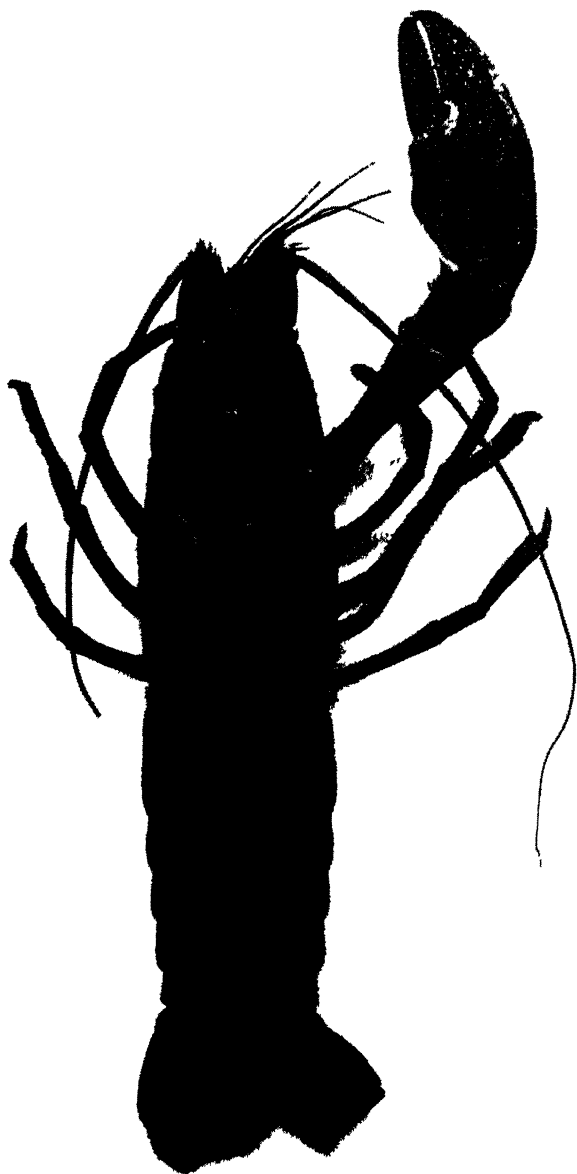


FIG. 2. *Cherax monticola*, new species, male, holotype. Dorsal view. Natural size.

Balim River Camp on Balim River, east of Habbema Lake, altitude 1700 meters, latitude $4^{\circ} 10' S.$, longitude $139^{\circ} E.$; November 28, 1938; Netherlands-American North New Guinea Expedition, 1938-1939; five males, 85-126 mm.; seven females, 81-177 mm. (holotypes and paratypes).

DESCRIPTION: The rostrum of the Balim River specimens almost reaches to the end of the antennular peduncle; even in young specimens it reaches beyond the middle of the last segment of that peduncle. In the Ibele River specimens, however, it reaches to or slightly beyond the base of the last joint of the antennular peduncle. The tip is curved downward a little. The upper surface is flat or somewhat hollowed, with the lateral margins elevated. These lateral margins are straight. The rostrum regularly tapers into a sharp apex, being elongate triangular in outline. It is about 1.8 to 1.9 times as long as broad at base. At each side one or two (seldom none or three) small, but distinct, lateral teeth are present in the ultimate third or quarter of the rostrum. The rostral carinae are distinct and reach to or slightly beyond the postorbital spines. The ultimate posterior part of the rostral carinae curves slightly inward. The postorbital carinae are distinct but fade away slightly before the middle of the distance between the postorbital spines and the cervical groove. A groove runs close along the outside of the postorbital carina. The carina curves somewhat outward posteriorly, and a blunt tubercle is present near the end of it. This tubercle is rather indistinct in juvenile specimens, while it moreover is more distinct in the Ibele River specimens than in those from the Balim River. The cervical groove is very distinct. Numerous rather widely separated tubercles are present on the lateral parts of the carapace behind the cervical groove. In the median region of the carapace the tubercles are absent, or faintly indicated in the posterior part. Numerous pits may, however, be observed in this median region. Also in the region anterior to the cervical groove only pits may be observed, except in a small area just behind the antennae, where there are some tubercles.

The epistome bears tubercles in the extreme lateral parts and just before the anterolateral angle of the oral field. These two tuberculated areas are connected posteriorly, but anteriorly they are separated by a smooth space. The epistome is smooth in the triangular median part and bears a deep pit in the anterior region. Behind this pit a shallow groove is present. The oblique margins



FIG. 3. *Cherax monticola*, new species, female, paratype. Dorsal view.
× 0.76.

of this median part are not elevated as they are in *Cherax communis* Holthuis. The rounded anterior part of the epistome is almost circular and ends in a minute anterior point. The keels of the sternum are sharp, and the lateral processes show no openings.

The abdomen is smooth but pitted in the median region. The pleurae are provided with some tubercles.

The eyes are small. The cornea is shorter than the stalk and narrower than the peduncular base.

The antennulae are normal in shape, resembling those of *Cherax communis*.

The antenna has a spine on the first and second joints of the peduncle. The scaphocerite has the outer margin somewhat convex, with the final tooth directed slightly outward. This final tooth overreaches the lamella. The shape of the lamella differs from that of *Cherax communis* by being not quite semicircular. The anterior part of the lamella is more narrow and more triangular in shape than in the other species. It shows, however, much more resemblance to the scaphocerite of *Cherax communis* and the other related forms from the Wissel Lakes region than to that of *Cherax lorentzi*, *C. albertisii*, or *C. divergens*. In the Balim River material the scaphocerite is more distinctly triangular than in the specimens from the Ibele River.

The oral parts are typical. The third maxilliped attains the base of the last segment of the antennal peduncle or overreaches it slightly.

The first legs are very heavy and are equal or subequal in shape. In the adult males they reach with almost the whole carpus, in females with only part of that joint, beyond the scaphocerite. The chela is strongly compressed. In my adult males it is about 2.3 times as long as broad, in my adult females 2.3 to 2.7 times. In juveniles this relation is 2.6 to 3. The fingers are as long as, or slightly longer than, the palm (in adult males they are relatively shorter than in the females). The fixed finger in adult males is about twice as high as the dactylus. In juveniles this difference is less marked. A row of small sharp tubercles extends over the entire cutting edge of both fingers, one or two tubercles being larger than the rest. In some cases all but the larger tubercles are inconspicuous. A single row of short oblique hairs may be present along the outside of the cutting edge, while tufts of longer hairs are visible on the inside, being especially numerous

near the base of the fingers. The palm is compressed and is shorter in the males than in the females. The outer surface is almost evenly convex and smooth, bearing only several pits. The inner surface is smooth and pitted, too, but has the median portion elevated to a low, broad ridge. The upper margin of the palm is serrate. A field of hairs is present on the outer surface, close along the upper margin. In my largest male (126 mm.) the larger part of the lower margin of the fixed finger is decalcified, showing as a whitish soft region. This soft region extends from the extreme anterior part of the palm proper to a short distance before the top of the fixed finger. In this same specimen a second area shows symptoms of decalcification, namely, a small region in the proximal half of the lower margin of the palm; here too the integument is soft (it is somewhat shriveled in this spirit specimen), but it still possesses the normal brown color of the chela and therefore is much less conspicuous than the decalcified area of the fixed finger. In smaller males (110 and 111 mm. in length) this second decalcified area is absent altogether, while the first is much smaller. In still smaller males (82, 90, 102, and 108 mm. in length) also the anterior soft region is absent. The carpus is slightly more than one-third of the length of the chela. The inner surface bears some tubercles and a conspicuous tuft of hairs; a sharp spine is placed just above this tuft of hairs. The anterior margin of the carpus bears three spines, one at the inner part of the upper side of the margin, the other two on the lower side. Two distinct tubercles are placed in the inner posterior part of the lower surface of the carpus. The merus is somewhat less than twice as long as the carpus and somewhat more than twice as long as high. The upper margin bears a serrate carina, which ends some distance before the anterior margin of the merus in a strong spine. The lower surface of the merus bears two almost parallel rows of spinules. The inner row is evenly serrate throughout; the outer row is formed by two strong spines, between which a smaller spinule often is present. A strong spine is placed at the inner lower part of the anterior margin of the merus. The ischium is slightly less than half as long as the merus. No hairs are present on either merus or ischium.

The second legs reach to the end of the scaphocerite. The fingers are slightly longer than the palm. The carpus is as long as the fingers and half the palm combined. The merus is 1.5 times as long as the carpus. The ischium is half as long as the merus.

The third leg reaches with part of the fingers beyond the scaphocerite. The fingers are slightly shorter than the palm. The carpus is somewhat longer than the palm. The merus is about 1.5 times as long as the carpus, and twice as long as the ischium.

The fourth leg reaches with part of the dactylus beyond the scaphocerite, or fails to reach that far. The dactylus is four times

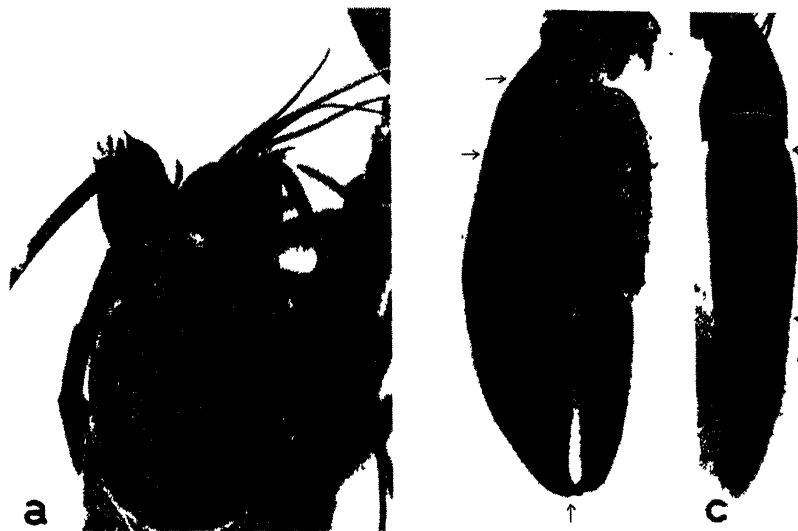


FIG. 4. *Cherax monticola*, new species, male, holotype. A. Anterior part of body in dorsal view. $\times 1.3$. B. Large chela, lateral view. $\times 1.5$. C. Large chela, ventral view. $\times 1.2$. Arrows in B and C indicate the extent of the uncalcified regions.

as long as high and bears a ventral row of 30 to 40 spinules, arranged comb-like. The propodus is twice to 2.5 times as long as the dactylus and about 1.3 times as long as the carpus. The merus is distinctly longer than the propodus and slightly less than twice as long as the ischium. The fifth leg reaches to the base of the scaphocerite or somewhat less far. The propodus is 2.5 times to thrice as long as the dactylus, 1.6 times to almost twice as long as the carpus, and as long as the merus.

The pleopods and uropods are normal in shape.

Very young specimens (e.g., a female of 81 mm.) differ from the adult material by having the tubercle at the end of the postorbital carina less distinct, the tubercles on carapace and abdomen less

conspicuous (though they always remain visible), and the first leg reaching with the chela only beyond the scaphocerite. Furthermore the chela of this leg is thrice as long as broad, the fingers are somewhat longer than the palm, the fixed finger is only a little higher than the dactylus, and the cutting edges of the fingers each bear only two teeth. Finally the second to fifth legs reach less far forward than in adult specimens.

SIZE: The size of the various specimens has already been given under the enumeration of the material. As the males of 108 mm. and less do not possess any indication of a decalcified area, they probably are not yet adult. It even is not certain whether or not the largest male (126 mm.) of the present collection has attained its full development; it is very possible that in still older specimens the second decalcified area will develop to a form similar to that of the anterior region. Of the 16 females of the material at hand only one, a specimen of 131 mm. from the Balim River, is ovigerous.

COLOR: No color notes were made in the field. The ground color of the body in my spirit material from the Balim River is either brownish or greenish. This difference may be due to preservation, as the brownish specimens (the two largest females and a small male) came from one jar, while the specimens from the other jar all were greenish gray. A violet or red tinge may be observed on the lateral parts of the carapace and the median region of the abdomen, the posterior margins of the segments excluded. The pleurae generally have a yellowish tinge. The chelipeds are brown. In younger specimens this color is a very light yellowish brown, in adults rather dark. The fingers and generally also a spot on the palm are of a much darker color than the rest of the chela. Juvenile specimens are lighter and of a more uniform color than the adults.

The specimens from the Ibele River also have the ground color of the body yellowish brown or greenish gray. The reddish color of the carapace and abdomen is markedly less distinct, if visible at all. In adult specimens the large chelipeds are dark greenish brown or dark green, the fingers sometimes being darker than the rest. Juvenile specimens are yellowish brown all over. A curious feature in these Ibele specimens is the rose color of the membranous part of the tail fan and of the antennular and antennal flagella.

TYPE: The largest male from the Balim River is the holotype; the other specimens are paratypes.

NATIVE NAME: Le Roux (1948, p. 317) makes the following interesting remark in his monograph on the Mountain Papuans of New Guinea (translated into English): "According to information which I obtained from the inhabitants of the Doraboe Valley, a large species of crayfish, named talò, is much fished for in the country of the Ndani by the Mbagimè-koma and Zoegimè-koma [Prau-people] of the great Balim Valley." These crayfishes doubtless belong to the species described here, as they originate from the same locality.

ECONOMIC IMPORTANCE: Dr. L. J. Toxopeus informed me that the native population of the Balim River Valley uses these crayfishes for food. The animals were either shot with three-pointed arrows or captured with a sort of fish trap. Two specimens from the Ibele River material and two specimens from the Balim River show holes in the body, which probably are caused by the above mentioned three-pointed arrows. As the crayfish is common in the Balim River and its branches (see also Archbold, Rand, and Brass, 1942, p. 256) it is of a considerable economic importance for the native population.

COMMENSALS: Many of the crayfishes from both localities have the egg capsules of *Temnocephala* attached to the body. Generally these egg capsules are arranged in circles around the body of the commensal itself (the *Temnocephala* in my material have disappeared, however, so that only the circles of eggs remain to indicate their former presence). Some crayfishes from the Ibele River had the lower surface of the large cheliped with a very great number of these egg capsules placed close together. Also in some other places the egg capsules could be observed, being placed in a more or less irregular way. The egg capsules are fastened to the body of the host with one of the narrow ends, just as in the *Cherax* species of the Wissel Lakes region.

REMARKS: The present species shows a close resemblance to *Cherax communis* Holthuis from the Wissel Lakes, but it may be distinguished by the following characters:

1. The rostrum is more triangular, narrowing gradually towards the apex and bearing less lateral teeth.
2. The rostral carinae converge, the postorbital diverge, posteriorly; in *C. communis* these carinae generally are straight. The tubercle at the end of the postorbital carina is absent in *C. communis*.

3. The abdominal pleurae are tuberculated in the present form and smooth in *C. communis*.
4. The scaphocerite is more triangular than in *C. communis*.
5. The epistome has the lateral margins of the median part not elevated like a ridge as in *C. communis*.
6. The oral field is narrower.
7. The first chelae of the adult male have one or two decalcified areas on the lower margin.

OCCURRENCE: The species for the first time was found by the Nederlandsche Wetenschappelijke Centraal Nieuw Guinea Expeditie 1920-1922 (Netherlands Scientific Central New Guinea Expedition 1920-1922), itineraries of which are given by Kremer (1922, 1923) and Lam (1927-1929, 1945). The crayfishes were found by that expedition in pools in the upper Balim basin, slightly west of Habbema Lake, at an altitude of approximately 3300 meters. This locality is slightly higher up the Balim River than the localities at which the present specimens of the Third Archbold Expedition were collected. Kremer (1923, p. 30) gives a photograph of such a crayfish pool and remarks that the expedition, on its way to the top of Mt. Wilhelmina, caught the crayfishes in these pools and, although the animals were of modest size, they were collected in such numbers that they served as food for members of the expedition. As far as I can ascertain, the 1920-1922 expedition took home no material of these crayfishes. The zoologist of this expedition, Jhr. W. C. van Heurn, and the botanist, Dr. H. J. Lam, participated in only the first half of the expedition, while it was in the second half that the Balim River and the summit of Mt. Wilhelmina were reached.

Cherax monticola seems to occur only in the Balim and Ibele rivers and in the pools mentioned above. In Habbema Lake no crayfish is found, as is emphatically stated in three different sources. Kremer (1923, p. 43) states, "visch en kreeften kregen wij er niet uit" (we got no fish or crayfish from it [Habbema Lake]). Toxopeus (1939, p. 27) makes the remark: "Visch ontbrak geheel, evenals iedere Crustacee" (fish totally lacking, as was also any crustacean). Finally Archbold, Rand, and Brass (1942, p. 268) state, "No crustacean was actually taken from the lake, but a dead crayfish about twenty centimeters long was picked up on the adjacent grasslands." The origin of this dead crayfish is not very clear. Perhaps it was dropped by one of the natives, who may have carried the specimen as an article of food. I have not seen this particular specimen.

The Balim River at the localities where the crayfishes were found is actually on the north side of the central mountain range of New Guinea. East of the summit of Mt. Wilhelmina, however, it breaks through this range and joins the Eilanden River, which empties into the Arafura Sea on the southwest coast of New Guinea.

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AMERICAN POLYDESMOID MILLIPEDS OF THE GENUS *SIGMORIA*, WITH NOTES ON DISTRIBUTION

BY RICHARD L. HOFFMAN

Through the kindness of Dr. Willis J. Gertsch, Associate Curator of Insects and Spiders, the American Museum of Natural History, I have been able to examine a large number of polydesmoid millipeds from eastern United States. Two of the species included, both members of the xystodesmid genus *Sigmoria*, are represented by specimens of considerable interest. It is felt that information on these animals, together with notes and records on other species accumulated separately, may profitably be assembled and presented in the form of a brief account of the genus as currently known.

I am assembling materials for monographic revisions of the larger genera of the Xystodesmidae; since these projected papers will include thorough descriptions and drawings of taxonomic characters, the present account is to be considered a preliminary one.

In addition to the material from the American Museum, I have studied specimens belonging to the United States National Museum, the Museum of Comparative Zoölogy, and the Carnegie Museum. For the opportunities to examine them, I am indebted to Dr. E. A. Chapin, Dr. Joseph Bequaert, and Mr. Gordon K. MacMillan. Dr. Mike Wright, Tusculum College, Greeneville, Tennessee, has sent me much-appreciated material from western North Carolina.

SIGMORIA CHAMBERLIN

Sigmoria CHAMBERLIN, 1939, Bull. Univ. Utah, vol. 30, no. 2, p. 7. Genotype, *S. munda* Chamberlin, by original designation.

DIAGNOSIS: Large xystodesmid millipeds characterized in particular by the male gonopods, in which one prefemoral process, of variable size and shape, is present; the prefemoral division is considerably swollen and setose; and the femur and tibiotarsus are fused without perceptible suture or joint, forming a telopodite element which is strongly differentiated from the prefemur and which is bent distally into a sigmoid curve. Gynopods of the female large, with the receptacle well developed, box-like, the valves broad, their distal faces corrugated; entire organs without setae.

Dorsum gently arched, completely smooth; keels broad and overlapping; repugnatorial pores dorsal in position. Sternites without spines at bases of legs. Coxae and prefemora with well-developed ventral spines. Terminal tarsal claw stout, with a light sinuous curve.

Color pattern variable, typically black dorsally with caudolateral halves of the keels yellow, orange, or red; often with a transverse band of the same color across dorsum on caudal edge of the tergites. Pleurites yellowish.

RANGE: Appalachian Mountains from western South Carolina to central West Virginia; Nashville Basin of central Tennessee; eastern Texas.

SPECIES: Fourteen, as listed below.

***Sigmoria aberrans* Chamberlin**

Sigmoria aberrans CHAMBERLIN, 1939, Bull. Univ. Utah, vol. 30, no. 2, p. 8, figs. 24, 25.

TYPE LOCALITY: Linville Falls, North Carolina.

TYPE SPECIMEN: Collection of R. V. Chamberlin.

DISTRIBUTION: Chamberlin's drawings cited above are not particularly useful for identification, and it was not until August, 1949, when I obtained a topotype at Linville Falls, that I was able to associate the name *aberrans* with a number of undetermined specimens on hand from the southern Appalachians.

The following localities add a great deal to the range of the species, heretofore known only from the type locality:

Virginia: *Patrick County:* Lovel's Creek, 2 miles north of North Carolina line, north of Mount Airy, North Carolina, June 13, 1937, L. P. Schultz and E. D. Reid (U.S.N.M.). *Washington County:* Holston Mountain, near Damascus, August 14, 1941,

Dr. and Mrs. S. T. Brooks (C.M. No. 75); Straight Branch at Dripping Rock, near Damascus, August 3, 1941, Brooks (C.M. No. 52); opposite Mendota, southeast side of Clinch Mountain, July 30, 1941, Brooks (C.M. No. 45); Clinch Mountain at Duncansville (location unknown), July 29, 1941, Brooks (C.M. No. 41).

North Carolina: *Ashe County*: Mill Hill and vicinity, July–August, 1922, C. M. Breder, Jr. (A.M.N.H., many specimens). *Burke County*: Linville Falls, August 12, 1910, R. V. Chamberlin (types), August 3, 1949, R. L. Hoffman (topotype). *Watauga County*: Boone, Appalachian State Teachers College, June 18, 1948, Mike Wright (R. L. H. No. 6-1848-1).

These records indicate a fairly extensive range centered around the Iron Mountains of the Southern Blue Ridge Physiographic Province. In a general way, the range of *aberrans* is very similar to that of the plethodontid salamander *Plethodon yonahlossee* Dunn. The Clinch Mountain, Virginia, localities are of interest in being outside of the Blue Ridge, on the northwest side of Washington County in the folded Appalachians. Doubtless *aberrans* occurs in northeastern Tennessee in the Iron Mountains and possibly the Unakas.

Despite the occurrence of the species in a mountainous region, it would seem that it does not ascend very high and may be found to be a valley form. I did not obtain any at Mount Rogers, Virginia (5000–5700 feet), nor did the Brooks find specimens at high elevations during their extensive malacological collecting in southwest Virginia. This observation, indeed, holds generally for the other Appalachian forms of *Sigmoria*, which occur widely at lower elevations throughout western North Carolina.

***Sigmoria brachygon* Chamberlin**

Sigmoria brachygon CHAMBERLIN, 1940, Ent. News, vol. 51, pp 283–284, fig. 2

TYPE LOCALITY: Glen Bald, Pisgah National Forest, North Carolina.

TYPE SPECIMEN: Collection of R. V. Chamberlin.

DISTRIBUTION: Known only from the type locality, which is located approximately 7 miles southwest of Asheville, in Buncombe County, North Carolina.

***Sigmoria conclusa* Chamberlin**

Sigmoria conclusa CHAMBERLIN, 1939, Bull. Univ. Utah, vol. 30, no. 2, p. 8, figs. 22, 23.

TYPE LOCALITY: "Altapass, Tennessee" (*sic*).

TYPE SPECIMEN: Collection of R. V. Chamberlin.

DISTRIBUTION: Known only from the type locality, which is actually in Mitchell County, North Carolina, instead of in Tennessee as originally cited.

***Sigmoria divergens* Chamberlin**

Sigmoria divergens CHAMBERLIN, 1939, Bull. Univ. Utah, vol. 30, no. 2, p. 8, figs. 19–21.

TYPE LOCALITY: Landrum, Spartanburg County, South Carolina.

TYPE SPECIMEN: Collection of R. V. Chamberlin.

DISTRIBUTION: Known only from the type locality.

***Sigmoria evides* (Bollman)**

Fontaria evides BOLLMAN, 1887, Proc. U. S. Natl. Mus., vol. 10, p. 620.

Sigmoria evides CHAMBERLIN, 1939, Bull. Univ. Utah, vol. 30, no. 2, p. 8.

TYPE LOCALITY: Mossy Creek, Jefferson County, Tennessee.

TYPE SPECIMEN: In the United States National Museum, a male in which only one gonopod was developed; this was removed and is now lost, so that the identity of the species cannot be ascertained without topotypical material.

DISTRIBUTION: Known only from the type locality.

***Sigmoria furcifera* Hoffman**

Sigmoria furcifera HOFFMAN, 1949, Proc. U. S. Natl. Mus., vol. 99, pp. 387–389, pl. 27, figs. 17, 18.

TYPE LOCALITY: Near Pineville, Wyoming County, West Virginia.

TYPE SPECIMEN: U.S.N.M. No. 1809, male.

DISTRIBUTION: This species is the northernmost representative of the genus at present. An additional record may be given here: West Virginia: *Lewis County*: 4-H Camp, Jackson Mill, September 10, 1938, G. K. MacMillan (C.M. No. 59), a female referred to this species with some hesitation.

Sigmoria gracilipes Chamberlin

Sigmoria gracilipes CHAMBERLIN, 1947, Proc. Acad. Nat. Sci. Philadelphia, vol. 99, p. 29, fig. 15.

TYPE LOCALITY: Pine Mountain, Bell County, Kentucky.

TYPE SPECIMEN: A.N.S.P. No. 9952, male.

DISTRIBUTION: Known from the type locality only.

Sigmoria houstoni Chamberlin

Sigmoria houstoni CHAMBERLIN, 1943, Proc. Biol. Soc. Washington, vol. 56, p. 144, fig. 1.

TYPE LOCALITY: Houston, Harris County, Texas.

TYPE SPECIMEN: Collection of R. V. Chamberlin.

DISTRIBUTION: This species is of unusual interest in light of its occurrence in central eastern Texas. There are a few other similar cases of "misplaced" Appalachian species in Texas (in insects and salamanders) but there is not enough information on millipeds to permit speculation on the exact nature of this phenomenon. One possibility is that *houstoni* represents a relict form of an earlier time when conditions permitted continuity of the faunas of the Appalachians and the Mexican Plateau. The presence of the isolated *Nannaria tuobita* (Chamberlin) in New Mexico lends some credence to this idea.

Sigmoria latior (Brölemann)

Fontaria latior BRÖLEMANN, 1900, Mem. Soc. Zool. France, vol. 13, p. 123, pl. 6, figs. 37-42.

Apheloria latior ATTEMS, 1938, Das Tierreich, no. 69, p. 168.

TYPE LOCALITY: "North Carolina."

TYPE SPECIMEN: Location unknown (Paris Museum?).

DISTRIBUTION: *Sigmoria latior* was described from an undesignated locality in North Carolina and has not since been reported, hence it is of interest to publish the first definite locality for the species: North Carolina: *Polk County*: Tryon, J. T. Nichols (A.M.N.H., two specimens).

Although well described by Brölemann, his species *latior* has been overlooked by all American workers. The very good drawings of the gonopods clearly represent a *Sigmoria*, but this is the first use of the name in proper combination. The species is related to *aberrans* and *furcifera*.

Sigmoria mariona Chamberlin

Sigmoria mariona CHAMBERLIN, 1939, Bull. Univ. Utah, vol. 30, no. 2, p. 9, figs. 17, 18.

TYPE LOCALITY: Marion, McDowell County, North Carolina.

TYPE SPECIMEN: Collection of R. V. Chamberlin.

DISTRIBUTION: Heretofore known only from the type locality, *mariona* is herewith recorded from an additional locality about 25 miles to the east: North Carolina: *Burke County*: Morganton, no date, H. K. Morrison (M.C.Z., three specimens).

Both of the stations for this species are in typical flat Piedmont terrain, in the Catawba River Valley.

Sigmoria mimetica (Chamberlin)

Fontaria mimetica CHAMBERLIN, 1918, Psyche, vol. 25, pp. 29-30.

TYPE LOCALITY: Nashville, Davidson County, Tennessee.

TYPE SPECIMEN: Male, in the Museum of Comparative Zoölogy.

DISTRIBUTION: Known only from the type locality.

This form was described without figures of the male gonopods, and in consequence its proper generic position has remained unknown until I recently examined the type at Harvard. The gonopods are suggestive of those of *S. divergens* and bear a strong superficial resemblance to the sort typical of the genus *Tucoria*. Publication of pertinent drawings is delayed in anticipation of securing females for study as well.

Sigmoria munda Chamberlin

Sigmoria munda CHAMBERLIN, 1939, Bull. Univ. Utah, vol. 30, no. 2, p. 8, figs. 15, 16.

TYPE LOCALITY: Hot Springs, Madison County, North Carolina.

TYPE SPECIMEN: Collection of R. V. Chamberlin.

DISTRIBUTION: Known only from the type locality and from Asheville, Buncombe County, North Carolina, both on the French Broad River.

Sigmoria stenogon Chamberlin

Sigmoria stenogon CHAMBERLIN, 1942, Bull. Univ. Utah, vol. 32, no. 8, p. 5, fig. 12.

TYPE LOCALITY: Bennet Gap Road, Pisgah National Forest, North Carolina.

TYPE SPECIMEN: Collection of R. V. Chamberlin.

DISTRIBUTION: Known only from the type locality. Bennet Gap is on the western edge of Transylvania County, 6 miles northwest of Brevard.

Sigmoria zyga Chamberlin

Sigmoria zyga CHAMBERLIN, 1949, Proc. Biol. Soc. Washington, vol. 62, p. 3 fig. 2.

TYPE LOCALITY: Between Hot Springs and Paint Rock, Madison County, North Carolina.

TYPE SPECIMEN: Collection of R. V. Chamberlin.

DISTRIBUTION: Known from the type locality only.

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STUDIES OF PERUVIAN BIRDS. NO. 57 THE GENERA *COLIBRI*, *ANTHRACO-* *THORAX*, *KLAIS*, *LOPHORNIS*, AND *CHLORESTES*

BY JOHN T. ZIMMER

In the following paper, names of colors are capitalized when direct comparison has been made with Ridgway's "Color standards and color nomenclature."

Colibri delphinae (Lesson)

Ornismya Delphinae LESSON, 1839, Rev. Zool., vol. [2], p. 44—no locality; Santa Fé de Bogotá suggested, Berlepsch and Hartert, 1902.

Mouth of Río Curaray, 1 ♂; Huarandosa, 2 ♂, 3 ♀, 1 (?); San Ignacio, 2 ♀, 2 (? ♀); Río Seco, 5 ♂, 1 ♀.

A series of over 90 specimens from Guatemala, Costa Rica, Panamá, Colombia, Venezuela, Trinidad, British Guiana, Ecuador, and Perú, shows no differentiation other than that due to age or sex.

Peruvian records are from Rioja, Huambo, Nuevo Loreto, and Cosñipata. The absence of records from the central-eastern part of the country, between the last two localities mentioned, is surprising.

Colibri thalassinus crissalis Todd

Colibri cyanotus crissalis TODD, 1942 (Dec. 31), Ann. Carnegie Mus., vol. 29, p. 292—Incachaca, Bolivia; ♂; Carnegie Mus.

This is an unsatisfactory form that has already been rejected by Bond and de Schauensee (1943, Proc. Acad. Nat. Sci. Philadelphia, vol. 95, pp. 204-205) who were unable to confirm its

described character of nearly uniform under tail-coverts on which the greenish centers of the feathers were reduced or wanting. This character is, it is true, quite variable and not always clear-cut, but in general I find that *C. t. cyanotus* from Venezuela has the area in question more pronouncedly marked with green and the margins of the feathers deeper buff, on average, than is the case with birds from Perú and Bolivia, which agree so well that they must in any case belong to the same form. Furthermore, the general color of the southern birds, especially on the under parts, is rather lighter green than that of the Venezuelan series, individuals of which often show a bluish tinge in a small area in the center of the breast, not well defined. When these two geographically extreme populations are compared, without regard to the intermediate Ecuadorian and Colombian birds, there is enough difference, as seen in series, to justify a distinction in name, although the separation is not pronounced or perfect.

The Colombian and Ecuadorian birds present a greater problem, but on the whole they show an average of greater resemblance to the Venezuelan form. Perhaps a larger series from Ecuador than I have available would show a greater approach to *crissalis*, especially in the southern part of the country, but, for the present, assignment to *cyanotus* is indicated.

Presumably all Peruvian records of *cyanotus* (or *cyanotis*) belong together and may be assigned to *crissalis*. These embrace records from Tambillo, Culumachay (Maraynioc), Idma, Huaisampillo, and "High Peru."

It may be remarked that Elliot's "*Petasophora rubrigularis*" (1878, Smithsonian Contrib. Knowledge, no. 317, p. 51, footnote) was based on an abnormal individual of the *thalassinus* group, not of *coruscans* under which it has been cited by various authors. The type is before me, a bird not fully adult, having the brilliant throat area limited to an elongate median patch, leaving the chin and sides of the throat bluish green. This bright patch, as was described, is pinkish instead of green. In addition, the tail is dull in general coloration though with the characteristic pattern of the species and furthermore with the basal half of the median feathers pale brownish. Proportions are those of *thalassinus*, and the bluish tone of the chin suggests assignment to *thalassinus thalassinus* and, although there is no locality on the label other than "New Grenada" (the bird came to Elliot in a large consignment of trade-skins that he thought might have been from

Bogotá, as indeed many of them probably were), the preparation is not that of a "Bogotá-skin" but is very like numerous examples of this and other species accredited to Guatemala. Everything being considered, I believe this type may well have been from that country.

SPECIMENS EXAMINED

C. t. thalassinus.—

MÉXICO:

San Luis Potosí, Alvarez, 7 ♂;
Jalapa, 1 ♂, 1 ♀;
Oaxaca, 3 ♂;
Jalisco (Sierra de Cayutlan and Mascota), 4 ♂;
Guerrero, Chilpancingo 4 (?);
"México," 1 ♂, 2 (?).

GUATEMALA:

(Vera Paz, Momocastenango, Quetzaltenango, Finca Sepacuite, Chichicastenango, and Volcán de Fuego), 7 ♂, 4 ♀, 1 (?);
? "New Grenada," 1 (?) (type of "*rubrigularis*").

C. t. minor.—

HONDURAS:

(Merendón, Montaña Vasquez, and Rancho Quemado [Tegucigalpa]),
15 ♂, 3 ♀.

C. t. cabanidis.—

COSTA RICA:

(Escazú, Irazú, Volcán Irazú, San Jeronimo, Aguas Calientes, La Carpintera, Volcán Turrialba, San José, Cartago, La Palma de San José, and Barba), 8 ♂, 2 [♂], 3 (?).

PANAMÁ:

(Cerro Flores, Chitrá, Boquete, and Chiriquí), 8 ♂, 3 ♀.

C. t. cyanotus.—

VENEZUELA:

(Caracas, Colonia Tovar, Cumbre de Valencia, Santa Ana Valley, Galipán, Rincón San Antonio, Cumaná, páramo at head of Chichirivichi Valley, Carapas, Mérida, Culata, Conejos, Escorial, Nevados, and Montañas Sierra), 20 ♂, 5 ♀, 1 [♀], 13 (?).

COLOMBIA:

(Río Toché, Santa Elena, El Eden, Antioquia, La Laguna, Cerro Munchique, "Bogotá," Valparaiso [Santa Marta], and El Libano, 10 ♂, 5 [♂], 4 ♀, 12 (?).

ECUADOR:

(Ibarra, Guala, El Chirál, Río Oyacachi, below San José, "Napo," Baeza, Sabanilla, and "Ecuador,"), 3 ♂, 2 [♂], 3 ♀, 1 (?).

C. t. crissalis.—

PERÚ:

Chugur, 4 ♂;
Seques, 4 ♀, 2 [♀];

La Lejia, 1 ♂;
 Utcuyacu, 1 ♂;
 Panao, 3 ♂¹;
 Santo Domingo, 1 ♂, 1 ♀;
 Oconeque, 1 ?♀.

BOLIVIA:

Incachaca, 1 "♂";
 Ocara, 1 ♂.

Colibri serrirostris (Vieillot)

Trochilus serrirostris VIEILLOT, 1816, Analyse, p. 69—Brazil.

Trochilus petasophorus WIED, 1821, Reise nach Brasilien, vol. 2, p. 191—Bahia, border of Minas Gerais (cited in Beiträge zur Naturgeschichte von Brasilien, 1832, vol. 4, pt. 1, p. 78); cotypes in Amer. Mus. Nat. Hist.

Colibri crispus SPILX, 1824, Avium species novae . . . Brasiliam, vol. 1, p. 80, pl. 81, fig. 1—Rio de Janeiro; Munich Mus.

Grypus vieilloti STEPHENS in Shaw, 1826, General zoology, vol. 14, p. 256.

Trochilus ianthinotus "Natt." WIED, 1832, *tom. cit.*, p. 76—cited in synonymy of *T. petasophorus*.

Petasophora gouldi BONAPARTE, 1850, Conspectus avium, vol. 1, p. 69—Bolivia.

The only basis for the consideration of this species as a Peruvian bird is the record by Tschudi (1844, Arch. Naturgesch., 10th year, vol. 1, p. 297, and 1845, Fauna Peruana, Aves, pp. 246, 250) from the "Waldregion" which presumably indicated the Chanchamayo-Junín territory. His description of the plumage is reasonably satisfactory, but the measurements are not. The total length is given as 8 inches, the tarsus 3 lines, and the proportion of tarsus to wing as 1:18 which supplies a wing length of some 4.5 inches, about that of *Pterophanes cyanopterus* but considerably larger than is found in any member of the present genus. Furthermore, *Colibri thalassinus crissalis*, as is noted on a previous page, occurs in the Chanchamayo region and may have fairly pale (but not pure white) under tail-coverts, but it was not found by Tschudi. Other collectors in the region have failed to find *serrirostris*. The nearest locality of record appears to be Sandillani, in the La Paz region of Bolivia, which is not too far from the Chanchamayo region of Perú to discredit the possibility of the bird's appearance in the latter area, but confirmation is much to be desired.

It may be well to call attention to the fact that specimens from Rio de Janeiro, São Paulo, Goiaz, and Minas Gerais examined in

¹ Specimens in Chicago Natural History Museum.

the present connection have the "ear-tufts" on average bluer and less reddish than birds from Matto Grosso, Bahia, and Argentina. There are, however, too many intermediate examples to permit any taxonomic distinction, although the extremes are not matched in both series. Enough names are available in the synonymy to supply a subspecific term for whichever part of the population might be found in need of one, a point that would require determination of the exact application of some of the names (including *serrirostris*).

I believe the systematic position of *serrirostris* is adjacent to the *thalassinus* group, to which it shows greater affinity than to *coruscans*.

SPECIMENS EXAMINED

C. serrirostris.—

BRAZIL:

[Bahia], 2 ♂ (cotypes of *petasophorus*);

Morro de Chapéu, 2 ♂;

Goiaz, Fazenda Esperança 1 ♂, 2 ♀, 1 (?);

Minas Gerais (São Benedicto, Fazendinha, Santa da Pedra Menina, Rio Caparaó, As Macieras, west of Boa Espera, and Varzea da Congonhas), 10 ♂, 1 ♀, 1 (?);

Rio de Janeiro, Alto Itatiaia, 1 ♂;

"Rio," 2 (?);

São Paulo (Piquete and Ypanema), 5 ♂, 1 (?);

Matto Grosso, Chapada, 8 ♂, 2 ?♂, 6 ♀, 2 ?♀, 4 (?);

"Brazil," 2 (?);

Mattodentro, 1 (?).

ARGENTINA:

Tucumán, 2 ♂;

Vipos, Tucumán, 1 ♂, 1 ♀.

Colibri coruscans coruscans (Gould)

Ramphodon Anais LESSON, 1833, (not *Ornismya Anais* Lesson, 1831 = *Colibri t. thalassinus*), Les trochilidéés, p. 146, pl. 55—"México."

Trochilus (Petasophora) coruscans GOULD, 1846, Proc. Zool. Soc. London, pt. 14, p. 44—South America; British Mus. (Aberration.)

Petasophora iolota GOULD, 1847, Proc. Zool. Soc. London, pt. 15, p. 9—Bolivia; British Mus.

Pinarolaema buckleyi GOULD, 1882, Ann. Mag. Nat. Hist., ser. 5, vol. 5, p. 489—Misque, Bolivia; British Mus. (Melanism.)

Colibri iolatus brevipennis CORY, 1918 (March), Field Mus. Nat. Hist., zool. ser., vol. 13 (pt. 2, no. 1), p. 221—Caracas, Venezuela; ♂; Chicago Nat. Hist. Mus.

Seques, 1 ♂; Chugur, 6 ♂; Huancabamba, 5 ♂, 1 ♀; Palambla, 6 ♂; Chachapoyas, 3 ♂; La Lejia, 1 ♂; Uchco, 1 ♂, 1 (?); San Pedro, 3 ♂, 2 ♀; Huarandosa, 3 ♂, 2 ♀; Huamachuco, 1 [♂]; Araqueda 1 [♂]; Cushi Libertad, 1 ♀; Oroya, 3 ♂; Chipa, 1 ♂; Utcuyacu, 3 ♂, 4 ♀; Acobamba, 1 ♂, 4 ♀; Ollantaytambo, 1 ♂, 2 ♀; Ttica-Ttica, 3 ♂, 2 ♀; Santo Domingo, 4 ♂; Puno, Lake Titicaca, 1 ♂; Arequipa, 1 ♂; Tinta, 1 ♂, 1 (?); Pisac, 2 ♂.

A long series of specimens from all parts of the range of this species shows no positive distinctions except in the case of the birds of the southern-Venezuelan highlands, *C. c. germanus*. Specimens examined are from northern Venezuela, Colombia, Ecuador, Bolivia, and northern Argentina, in addition to the Peruvian material listed above and 25 *germanus* from Mts. Roraima, Duida, and Auyan-tepui, Venezuela. Other Peruvian records are from Tambillo, Callacate, Chusgón, Cajabamba, Cajamarca, Macate, Hacienda Llagueda, Río Utcubamba, Choquisongo, Succha, Paucal, Achamal, Chirimoto, Nuevo Loreto, mountains near Huánuco, Panao, Vista Alegre, Chinchao, La Merced, La Garita, Tarma, Tapo, Hacienda Huarapa, Chospiyoc, Soriano, Acancocha, Algamarca, Maraynioc, Idma, Torontoy, Cuzco, San Miguel, Río Cadena, Cosñipata, Anco, Pausa, Huanta, Motil, Tulpo, and Matucana.

Four aberrations are at hand in the series of the typical subspecies. Two of these have the throat-patch largely purplish red as described for the type of *coruscans*. One of them, in fact, was compared by Elliot with the type. A third bird is melanistic, showing the pattern of the species obscurely except on the tail where it is a little more obvious. These three birds are all "Bogotá-skins." The fourth specimen is from Ttica-Ttica, Perú, and apparently was included by Chapman (1921, Bull. U. S. Natl. Mus., no. 117, p. 67) in "*iolata*" without comment. It is, however, an obvious hybrid and, although *coruscans* seems probable as part of the combination, the other part of the parentage I have not been able to determine satisfactorily.

The specimen is quite young, with soft plumage, with measurements matching those of adult *Colibri coruscans* (wing, 75 mm.; tail, 46; bill, 24.5). The general color is near Hair Brown, paler on the belly; all the dorsal feathers have narrow ochraceous tips which are stronger in the superciliary region and around the back of the head, forming a coronal border; there is a whitish spot be-

hind the upper posterior corner of the orbit; the belly feathers have whitish tips, and there is a somewhat elongate patch of white under the wing in the femoral tract; the throat shows a very faint gloss on the margins of the feathers which also have more dusky centers, suggesting the characteristic pattern of *coruscans*. The tail-feathers are narrower than in adult *coruscans* and show the subterminal dark band weakly in dorsal aspect, somewhat stronger in ventral aspect where the band is greenish; the basal area of the median rectrices is bluish gray and the same color appears progressively more restricted basad; beyond the dark band, the tips of the feathers are broadly grayish (near Mouse Gray) with a fine pale edge which on the outermost feathers is broader and continued well along the terminal third of the outer margin. The bill is quite noticeably arcuate—as much so as in *Campylopterus falcatus*, for example—and is black in color. Its present length, considering the immaturity of the plumage, is suggestive of much greater length when growth would have been completed, since the bills of very young hummingbirds are quite short compared with those of the adults. This is shown by some normal young *Colibri coruscans* now before me which do not resemble the Ttica-Ttica specimen in any of its peculiarities. For the present, therefore, I am unable to cite the specimen other than as *Colibri coruscans coruscans* ≥ ?. It is additional to the five birds from the same locality listed above.

***Anthracothorax nigricollis* (Vieillot)**

Trochilus nigricollis VIEILLOT, 1817, Nouveau dictionnaire, (nouv. éd.), vol. 7, p. 349—Brazil; I suggest Belem, Pará, as restricted type locality.

? *Lampornis nigricollis caeruleicauda* FLOERICKE, 1920, Mitteilung Vogelwelt, vol. 19, pp. 2, 3—? Colombia.

Anthracothorax violaccicollis CHAPMAN, 1928, Nat. Hist., vol. 28, no. 3, p. 284, 2 figs.—Barro Colorado, Canal Zone; a *lapsus calami*, not intended as new.

Anthracothorax nigricollis miki DUNAJEWSKI, 1938 (June 8), Acta Ornith. Mus. Zool. Polonici, vol. 2, no. 15, p. 324—Cumaria, Ucayali region, Perú; ♂; Warsaw Mus.

Puerto Indiana, 2 ♂; Apayacu, 3 ♂, 1 ♀; Santa Rosa, Ucayali, 4 ♂, 2 ♀; Pachisa, Río Huallaga, 1 ♂; Yarina Cocha, 1 (?); Nauta, 1 ♂.

These birds have been compared with a series of over 200 additional specimens from almost all parts of the known range of *nigricollis* (none are at hand from Tobago), without any basis

for the distinction of an east-Peruvian form having been discovered. In fact, I can find no distinctions of value in any part of the range and am not sure that the population of western Ecuador, *iridescens*, is clearly to be assigned to the same species, as will be discussed below.

The characters given for "*miki*" were said to consist of a decided blue border on each side of the median black stripe on the under parts, greener back than in Brazilian *nigricollis* (darker than in *iridescens*), blue instead of green median rectrices, and shorter bill. In all these respects Peruvian birds can be matched by many examples from other parts of the range, including Brazil.

It is curious that there appears to be no authentic record of *nigricollis* from eastern Ecuador. It occurs in southeastern Colombia (Morelia) and just north of the Amazon in Perú (Nauta, Puerto Indiana, and Apayacu), but the citation of Ecuador was based on an error. Ridgway (1911, Bull. U. S. Natl. Mus., vol. 50, pt. 5, p. 462) quoted the record of Sclater and Salvin (1866, Proc. Zool. Soc. London, p. 193) from Sarayacu, Perú, as "Sarayacu, e. Ecuadór," and later authors have continued the mistake. As far as I can learn, there is no other basis for Ecuadorian citation, although the occurrence of *nigricollis* in that country would not be surprising.

Peruvian records are from Yurimaguas, Jeberos, Pebas, Sarayacu, Chanchamayo, and La Merced.

I have cited only the synonyms that are reasonably certain to belong to *nigricollis*. There are eight other original descriptions of birds that have been assigned to this species with or without a query, five of which antedate *nigricollis* while the other three are of the same date. Since positive identification of these names appears out of the question with present information, I follow Simon in omitting reference to them.

Hellmayr (1929, Field Mus. Nat. Hist., zool. ser., vol. 12, no. 18, p. 388, footnote) remarks that *nigricollis* had not been found in French Guiana. In the material at hand are three "trade-skins" of characteristic "Cayenne-make" which suggest the possible occurrence of *nigricollis* in that country. A number of examples from Faro, Brazil, also suggest the possibility, since many birds show even subspecific identity in the populations of the two regions. Nevertheless, there appear to be no Cayenne specimens on record with accurate data.

***Anthracothorax prevostii iridescens* (Gould)**

Lampornis iridescens GOULD, 1861, Introduction to the Trochilidae, p. 65—Guayaquil, Ecuador; cotypes in British Mus.

I am not satisfied with the placement of *iridescens* as a conspecific of *nigricollis*. It is true that they have considerable similarity, but there are certain differences in which *iridescens* shows more resemblance to the *prevostii* group. The bill is both longer and heavier than in average *nigricollis*; the malar region of the adult males has a different luster and color, including the lores in some instances; the black ventral median stripe of the young males has, in most cases, prominent green tips, and the white lateral stripes are often strongly rufescent brown; the white of the cheeks in the females is broader, approaching the orbit more closely. In all these respects there is close approximation to some members of the *prevostii* group, but not to *nigricollis*.

There is, furthermore, some possibility of conflict in range with *nigricollis*. Todd (1942, Ann. Carnegie Mus., vol. 29, p. 294) recorded two examples of *iridescens* from Yumbo, north of Cali, Colombia. Three examples now before me from Cali are, on the other hand, unquestionable *nigricollis*. The two localities are less than 10 miles apart on the same side of the same cordillera, and unless there has been an error in labeling or identification, it must be assumed that the two forms occur virtually together. Yumbo would be an unusual locality for *iridescens* which otherwise is known to occur only at very low elevations in the arid coastal portion of western Ecuador and extreme northwestern Perú, and the record should be confirmed by other material from the Cauca Valley. It has been questioned by de Schauensee (1949, Caldasia, vol. 5, no. 23, p. 545).

I have no Peruvian specimens of *iridescens*, although a male from Santa Rosa, Ecuador, was taken not far from the border. Taczanowski, however (1877, Proc. Zool. Soc. London, p. 745), recorded two examples from Lechugal, which is on the Peruvian side of the Río Zurumilla, establishing the occurrence of the bird in Perú. Later (1884, Ornithologie du Pérou, vol. 1, p. 281) he synonymized *iridescens* with "*violicauda*" under which he placed the Lechugal birds, the only Peruvian specimens he had examined. Parts of his description of the different plumages rather certainly indicate *iridescens* but may have been taken from west-Ecuadorian birds which he had undoubtedly seen, having recorded Guayaquil

specimens in the previous year in a joint paper with Berlepsch (1883, Proc. Zool. Soc. London, p. 566). Nevertheless the Lechugal population is certain to be the same as that of Santa Rosa in the present instance.

It may seem that the range of *iridescens* is too far removed from that of other members of the *prevostii* group to favor consideration of conspecific relationship, but *A. p. viridicordatus* is equally distant from its nearest conspecies as far as present records indicate.

It is not impossible that *prevostii* and *nigricollis* ought to be considered as a single specific unit. The suggestion has been made by van Rossem (1938, Field Mus. Nat. Hist., zool. ser., vol. 23, p. 260) who claimed to have intergrading examples but was deterred from formal consolidation by a statement from Hellmayr (unpublished) that *nigricollis* and *viridicordatus* occurred together in parts of Caribbean Venezuela. I am not sure that they actually occur together. I have before me a series of eight examples that are certainly of the *prevostii* group and apparently referable to *viridicordatus*, although the locality, San Félix, Cumaná, Venezuela, is far from El Panorama, Río Auraré, the type locality. I also have four specimens of *nigricollis* from Cumanacoa, which San Félix closely approximates. I suspect, however, that *viridicordatus* may inhabit more open country and *nigricollis* the more wooded places, both of which I understand exist in that area. This possibility should be explored. It would help to explain the segregation of *iridescens* on the west coast of Ecuador without connection across the exceedingly humid west-Colombian terrain and eastern Panamá to join with *prevostii gracilirostris* in Costa Rica which is said to frequent more open places such as gardens and roadsides and not to enter the forest. A logical connectant a little closer to South America is the form *veraguensis* of the less humid Pacific section of western Panamá which has usually been considered as a distinct species but which differs from the *prevostii* group only by having the throat of the adult males entirely green instead of with a black median stripe. In other respects it resembles *prevostii*, and I suggest that it be placed with it as a well-defined but conspecific form. Until more is learned of the ecological restrictions of *nigricollis* and the *prevostii* group, however, I prefer not to propose their specific union.

In discussing the features of adult males, young males, and adult females in the preceding account, I have used the commonly accepted concept of those plumages. Van Rossem (*loc. cit.*)

suggested the possibility that fully adult females might resemble the adult males, having progressed from a plumage like that of young males, over a period of several years. Such a situation may indeed exist, as I found to be the case in some individuals of *Florisuga mellivora*, discussed in an earlier number of these Studies, but I have been unable to detect the same condition in the present species and am unable to discuss it formally.

Klais guimeti pallidiventris Sztolcman

Klais guimeti pallidiventris SZTOLCMAN, 1926 (Dec. 31), Ann. Zool. Mus. Polonici Hist. Nat., vol. 5, no. 4, p. 213—Huambo, Perú; ♂¹; Warsaw Mus.

Peruvian birds are distinguishable from those of Colombia, Venezuela, and Central America by their paler under parts, justifying the recognition of *pallidiventris*. Ecuadorian examples are intermediate. Some of the latter, especially those from the southern part of the country (Zamora and Sabanilla), approach the Peruvian population to a noticeable degree, but not all examples at hand are equally marked and some are indistinguishable from the darker *g. guimeti*. A single specimen, labeled "Napo," is likewise of possible assignment to *pallidiventris*, but may represent the extreme of individual variation in the nominate form. Without material from definite localities on the lower Napo, the possible occurrence of the Peruvian subspecies in that area is left in doubt. Birds from the region of the upper Napo average closer to *guimeti*.

I am inclined to resurrect *Mellisuga Merrittii* Lawrence (1860, Ann. Lyc. Nat. Hist., New York, vol. 7, p. 110—Veraguas, "New Grenada" [= Panamá], for the Central American population. Adult males from this region show the glittering cap, at least posteriorly, more bluish than do any of the South American examples, which have the crown violaceous or purplish. There are very few examples that are not assignable by this character, and the extremes of the two series are well apart. Only two adult males from Central America lack any decided bluish tinge on the head, and none of the South American birds has any pronounced blue except one or two molting specimens where the full color may not have been reached. Females appear to show no definite difference. On the basis of the adult males as shown by the present series, *merrittii* appears to deserve recognition and is separately listed in the material examined.

Peruvian records of *pallidiventris* are from Chayavitas, Huambo, Nuevo Loreto, Chanchamayo, Borgoña, Huaynapata, and possibly "Upper Amazons."

SPECIMENS EXAMINED

K. g. merrittii.—

NICARAGUA:

(Vizagua, San Juan Talpaneca, and Quilali), 2 ♂, 1 ♀.

COSTA RICA:

(Guayabo, Carrillo, Boruca, Escazú, Vera Blanca, and San Pedro), 9 ♂, 5 ♀, 2 "♀" [? = ♂], 1 (?).

PANAMA:

Veraguas, 1 (?) [? = ♂ imm.] (type), 4 ♂;

(Chiriquí, Tacarcuna, Ventorillo, and Gobernador Is.), 3 ♂, 2 [♂], 1 [♀].

K. g. guimeti.—

VENEZUELA:

(Cumbre de Valencia, Las Quiguas, San Esteban, El Limón, and Ejido), 5 ♂, 1 ♀, 1 [♀].

COLOMBIA:

(Andalucía, near Honda, Buena Vista, Bogotá, and "Colombia"), 4 ♂, 15 [♂], 1 ♀, 4 [? ♀].

ECUADOR:

Below San José, 7 ♂, 4 ♀;

Sabanilla, 1 ♂;

Zamora, 2 ♂, 3 [♂], 3 ♀;

"Napo," 1 ♂.

K. g. pallidiventris.—

PERÚ:

Santa Rosa, Río Marañón, 2 ♂, 2 ♀, 1 ? ♀;

Santa Rosa, upper Ucayali, 1 ♂;

Río Huacamayo, 1 ♂, 1 [♂], 1 ♀;

Candamo, 2 ♂.

Lophornis delattrei delattrei (Lesson)

(*O[rnysmia]* *Lophorinus*) *De Lattrei* LESSON, 1839, Rev. Zool., vol. 2, p. 19—no locality; "la Colombie" suggested by Lesson, 1843; Perú suggested by Simon, 1921, and Laubmann, 1930; I propose Moyobamba, Perú, as restricted type locality; [♂]; ? type lost.

Trochilus (*Lophornis*) *regulus* GOULD, 1846, Proc. Zool. Soc. London, pt. 14, p. 89—"Interior of Brazil"; ♂ ♂, ♀ cotypes in British Museum accredited to "[Bolivia]."

Lophornis lophotes GOULD, 1861, Introduction to the Trochilidae, p. 83—Perú; ♂; British Mus.

There is a slight possibility that Bolivian birds may prove to be separable from north-Peruvian ones. With the limited

amount of Peruvian material available I am unable to determine the point. A single adult north-Peruvian male is not distinguishable from Bolivian specimens, but three Peruvian birds sexed as females differ from the Bolivian females I have for comparison. Unfortunately, there is considerable variation in the females and young males throughout the genus *Lophornis*, and I have not been able to determine with accuracy the differences that may be due to age and sex.

Six females from Bolivia have the throat predominantly ochraceous-tawny or at least with distinct terminal spots of that color on the upper part, becoming sooty on the lower throat in three of the specimens, and developing a bronzy patch on the lowermost part of the throat in all but one of them, variable in size. The lower under parts also are strongly light cinnamomeous with little suggestion of green. One other example, sexed as a female, is somewhat more heavily speckled on the throat and has the breast distinctly greenish. An eighth Bolivian bird, marked as a female, is immature and has the whole lower part of the throat dusky, the upper part dull buffy whitish; the breast is distinctly greenish as in the last-named example, the occiput is dull brownish, and the back is slightly darker green than in the other Bolivian "females."

The three north-Peruvian "females" have the back darker green than the Bolivian specimens, and the lower rump and upper tail-coverts less coppery. The throat is whitish, with only a trace of cinnamomeous tinge, and strongly speckled with dusky. One of the three, an immature individual judging by the dark maxilla, has the spots on the lower throat shining green, suggesting that it is a young male. The breast also is greenish in the three examples.

A quite young "female" from the upper Ucayali (Santa Rosa) has most of the throat blackish, with some cinnamomeous brown feathers on the lower part and the center of the breast also cinnamomeous. The occiput is dusky and the back is not so dark green as in the north-Peruvian specimens, approaching the color of the Bolivian females.

The principal distinctions between the Peruvian and Bolivian specimens, therefore, are the darker back and more whitish and more heavily spotted throats of the former. The dorsal difference may be due to the fact that the Peruvian birds are of considerably more recent collection, or it may be that the Peruvian

examples are wrongly sexed young males. The latter is more likely since the males from the two regions are alike in this respect, and the north-Peruvian "females" match their dorsal color, with further close approximation in the young Bolivian "female" that has the very dark throat. It, too, probably is a male.

Should further collections in Perú and Bolivia authenticate a difference in the populations of the two regions, Gould's name *regulus* should be available for the Bolivian form. An examination of the cotypes of *regulus* should then be made, although I am unable to suggest any distinction likely to be found in the adult males since none is apparent in the specimens before me. Since one of the cotypes is said to be a female, its characters should prove of value.

In spite of Lesson's secondary suggestion of Colombia as the habitat of *delattrei* (1843, *Echo du Monde Savant*, 10th year, 2^e semestre, p. 758), his original description is of the present form, not of the Colombian subspecies later named *lessoni*. Simon (1921, *Histoire naturelle des Trochilidae*, p. 285, footnote) suggested the Peruvian origin of the type, since various other species described in the same paper came from Perú. On the same basis I have suggested a further restriction to Moyobamba which is specifically mentioned in connection with some of these other birds, and the material at hand verifies the occurrence of *delattrei* in the Moyobamba area.

Other Peruvian records are from Rioja and Borgoña.

SPECIMENS EXAMINED

L. d. lessoni.—

COSTA RICA:

Mojón, 1 ♂.

PANAMÁ:

(Chiriquí, Bogava, La Marea, Cocoplum, [Lion Hill], and "Panamá"), 8 ♂, 2 ♀.

COLOMBIA:

"Bogotá" and "New Grenada," 8 ♂, 10 (?);
within 20 miles of Honda, 1 [♂].

L. d. delattrei.—

PERÚ:

Río Negro, west of Moyobamba, 1 ♂, 3 "♀";
Santa Rosa, Río Ucayali, 1 ♀.

BOLIVIA:

Mapiri, 1 [♂], 1 ♀;

Yungas, 1 ♂;
Province of Sara, 2 ♂, 5 ♀;
"Bolivia," 2 ♂, 1 "♀";
"San Augustin, E. Bolivia," 1 (?).

Lophornis stictolopha Salvin and Elliot

Lophornis Reginae GOULD (*nec* Schreibers, 1833), 1847, Proc. Zool. London, pt. 15, p. 95—no locality; type or types from Antioquia, Colombia—Gould, 1855; [♂].

Lophornis stictolophus SALVIN AND ELLIOT, 1873 (April), Ibis, ser. 3, vol. 3, p. 280—new name for *Lophornis reginae* Gould.

Mouth of Río Santiago, 1 ♂; Pomará, 2 ♂, 3 ♀.

This species has not been recorded heretofore from Perú, although its occurrence at Zamora, Ecuador, indicated the probability that it reached the north bank of the Marañón where the present material was obtained.

A series of specimens from Colombia (Bogotá-skins), seven from Venezuela, and nine from Ecuador, with the Peruvian birds listed above, show no evident division of *stictolopha* into subspecies. The identification of females and young males is open to discussion. Simon (1921, Histoire naturelle des Trochilidae, p. 52, footnote) remarked that he knew of no character by which to identify with certainty the females of any of the species he placed in the genus *Lophornis*, and it is remarkable the similarity they show among themselves. Hartert (1900, Das Tierreich, no. 9, p. 219) stated that the bill of female "*reginae*" is 1 mm. shorter than that of female "*regulus*" [= *delattrei lessoni*], but in this I am sure he was mistaken. The reverse is true in the case of the males, at least on average, and females and young males from localities where *lessoni* has never been found show the same condition in comparison with birds from localities where *stictolopha* does not occur. In series of "Bogotá-skins" both forms occur and where the bill is apparently fully developed, with bicolored pattern, it is possible to arrange the specimens in two fairly well-distinguished series on this basis; young examples with wholly dark bill are more problematical unless the bill has already reached a length sufficient to indicate *stictolopha*.

Unfortunately, specimens of *lessoni* from Panamá and Costa Rica appear to have the bill longer, on average, than Colombian examples and equaling most *stictolopha* though not the extremes of that species. In addition, the southern subspecies of *delattrei*,

the nominate form, has the bill always of the larger size, and hence, if this form and *stictolopha* should at some future time be found to occur together, identification of the females and young males would here become a problem also. In this connection, a female labeled "Headwaters of Marañón, E. Ecuador," presumably from northern Perú, is indeterminate, since there is no indication as to the side of the Marañón from which it came, and the river appears to be the boundary between the two populations.

The separation of the females and young males in the material examined is, therefore, somewhat arbitrary; that of the adult males, of course, is based on plumage which is quite distinctive. There is an overlap in the length of bill in the males even in Colombia; two Colombian males of *stictolopha* have the bill only 8.5 mm. in length, and one Colombian and most of the Central American males of *lessoni* have it 9 mm. (the preponderating figure in *stictolopha*), while four of the Panamá birds reach 9.5. Accordingly, I have placed an arbitrary line of demarcation between 8.5 and 9 mm. for the tentative separation of the females and young with fully developed bills of the two forms in Colombia. Admittedly, some of the birds thus arranged will be wrongly identified, but on no other line of separation will the proportion of specimens of this sort in the two forms so nearly approach that of the adult males in the material at hand—a factor of possible significance.

In *stictolopha*, as in *delattrei*, I am unable to get a clear concept of the distinction of plumage in females and young males. Much of the material has no indicated sex on the labels, and the remainder is not clearly defined. Certain specimens of rather definite immaturity (with wholly dark bills) have almost the whole throat blackish, but some of these show the acquisition of a few bright green feathers that indicate they are young males. Other birds with bicolored bills have the throat nearly wholly rufescent or at least with a rufescent tinge, and a dark (blackish or dull greenish) pectoral band of varying width, and these I believe are fully adult females; several sexed examples agree with this conclusion. In an intermediate position are numerous individuals that have the pectoral band moderately broad and the throat relatively whitish, strongly speckled with blackish. Most of the birds in this condition have immature bills, but some of them do not, and if they are adults, they must be females; indeed, several are so sexed. A careful study of ample

material, accurately sexed, would be of considerable value.

It may be noted that Elliot marked two specimens in his collection as types of *stictolopha*, both of which are now before me. Since he and Salvin proposed the name as a replacement for Gould's preoccupied "*Reginae*," as they state in their introductory remarks, the type of *stictolopha* actually is the bird from which Gould drew up his description—a specimen submitted to him by a Mr. Linden whose brother was traveling in the Antioquia region of Colombia and had obtained the specimen. The present repository is unknown.

Of the two birds mistakenly labeled as types by Elliot, the male is an undoubted *stictolopha*, but the "female" has the bi-colored bill but 8 mm. in length and presumably belongs to *delattrei lessoni*.

Although *stictolopha* and *lessoni* are found in "Bogotá" collections, there appear to be no specimens with accurate data that indicate their occurrence at the same localities. The absence of *lessoni* or *delattrei* from eastern Ecuador and Perú north of the Marañón and the appearance of *delattrei* south of that barrier suggest geographical replacement with *stictolopha* completely interrupting any continuity between *delattrei* and *lessoni*, in spite of the fact that these last two are so similar that their specific affinity can hardly be doubted. There is comparable replacement of *ornata*, *gouldii*, *magnifica*, *delattrei*, and *stictolopha* throughout the combined ranges, and considerable similarity in many particulars which makes a fairly compact group. In the other direction, except in the case of *d. delattrei* and *d. lessoni* (I have not seen the Mexican *d. brachylopha*), the differences are sufficient to justify retention of each of them as a separate species.

***Lophornis chalybea verreauxii* J. and E. Verreaux**

Lophornis Verreauxii J. AND E. VERREAUX, 1853, Rev. et Mag. Zool., ser. 2, vol. 5, p. 193, pl. 6—Perú; Moyobamba accepted by Berlepsch and Hartert, 1902.

Lophornis Hauxwelli BOUCARD, 1892, Genera of humming birds, p. 37—Nauta, Perú; ♂, ♀ cotypes (? Paris Mus.).

Nauta, 1 ♂, 2 ♀; Pebas, 1 ♀; Iquitos, 2 ♂; Río Mazán, 1 ♂; Puerto Indiana, 1 ♂, 5 ♀; Santa Rosa, Río Ucayali, 3 ♂, 2 ♀; "Perú," 2 ♂.

The authority for the name for this form has been given variously

by different authors. The paper comprising the original description was undoubtedly written by Jules and Edouard Verreaux, although they cite Bourcier as authority for the name, probably from the label of the type. They appear as authors of the paper also in the list of contents at the end of the number of the *Revue* in which it appeared, but in the index to the entire volume Bourcier is given as author of the paper and the name. In Mulsant and Verreaux's "*Histoire naturelle des oiseaux-mouches*" (vol. 3, p. 221) Bourcier is cited as authority for the name, but on page 229, in a bibliography of papers by J. and E. Verreaux, the title of the original article again appears. Although there is no doubt that Bourcier planned to honor Edouard Verreaux by naming this bird for him, I see no way he can be credited even as part author since he had no connection with the original publication.

The spelling, date, and authorship of the specific name are also questionable. *T[rochilus] chalybeus* was published some time in 1822 by Vieillot (*Tableau encyclopédique et méthodique, Ornithologie*, pt. 2, livr. 91, p. 574—"le Brésil"), while *Trochilus chalybeus* Temminck appears in the text to plate 66 of the "*Nouveau recueil de planches coloriées*," issued in April, 1822. In this latter work, also, in the section entitled "*Tableau Méthodique*," issued in livraison 102 in January, 1839, the specific name is spelled *chalybaeus*. This "*Tableau*" was offered to supplant one issued in livraison 87, in January, 1831, where the spelling used is not ascertainable at the moment. The point of these later references is that the altered spelling may have been used on the cover of livraison 11 in which plate 66 appeared, dated June, 1821. It is known that, while the plates themselves carried no Latin names, and no text was issued until April, 1822, the covers of some, and probably all, of the early parts bore the scientific names of the species included in them. As far as I know, no cover of livraison 11 has come to light, and it is therefore impossible to say what name Temminck may have applied to his plate 66, figure 2, published in June, 1821, before the text to that plate appeared and before Vieillot's name was published. At the moment, therefore, we are obliged to accept *chalybeus*, 1822, as the name and date, and since Sherborn (*Index animalium*) has given priority to Vieillot in this instance, Vieillot may be considered as author in spite of the fact that Temminck rather certainly antedated him in the reference now lost.

Although there are numerous specimens and records of *ver-*

reauxii from northern Perú, it appears to be rather uncommon elsewhere. A single Bolivian record has been published; there is one bird from Ecuador recorded as in the British Museum, and in the collection at hand there is a single male from the Río Napo which may be Ecuadorian or Peruvian; in Colombia, almost all known specimens are "Bogotá skins," although there is a record from Medina and one (based on feathers in an Indian headdress) from the Putumayo.

Peruvian records, other than those from localities listed above, are from Yurimaguas, Chayavitas, and Jeberos.

I am adopting the generic name *Lophornis* (instead of *Polemistria*) for the present species and some others, and including *Paphosia*, *Popelairia*, and *Discosura*; presumably *Lithiophanes* belongs here also, if it is not a hybrid as has been intimated by its describer. Simon recognized 10 genera for the assemblage. As remarked by Hartert (1900, *Das Tierreich*, no. 9, p. 216), the genus *Lophornis* is notable for the variety of ornamental plumes developed by the males while the females remain very similar, and consequently the group has been broken into a number of [supposed] genera. He himself recognized "*Popelairia*," and *Discosura*, but not *Paphosia* and *Polemistria*, although his remarks are equally applicable to them.

All the forms embraced in these commonly accepted genera have a variety of features in common. The shape of the bill, slender and sharp, with a slight reflexion toward the tip of the mandible, is the same in all. The white or whitish band across the rump, followed by a more or less coppery area on the upper tail-coverts; the development of a strong malar tuft in the adult males of most of the species and the presence of a broad whitish malar stripe in young males and females; the usual presence of a strong whitish or pale-colored patch in the center of the breast in nearly all of the species in adult male plumage and all of the females and young—these characters give a decidedly homogeneous aspect to the various members of this assemblage in which the only striking differences are those of the ornamental plumes of the adult males, including the variously shaped tails, crests, and gorgets.

Furthermore, in each of the commonly recognized genera (*Lophornis*, *Polemistria*, *Paphosia*, *Popelairia*, and *Discosura*) the various forms, whether species or subspecies, appear to be strictly geographical replacements of one another; there is no more than

one form of each in any locality. Although the distinctions in each group are sufficient to warrant the recognition of various species, as I have discussed under *Lophornis stictolopha*, the members of each so-called genus, with the possible exception of *chalybea* and *pavonina*, offer but a single "superspecies" in each case, making the "genera" in a sense monotypic. With all these factors considered, I think a single genus for all the forms gives the best expression of their relationship.

Lophornis popelairii (Du Bus)

Trochilus Popelairii DU BUS, 1846, Esquisses ornithologiques, livr. 2, pl. 6 and text—Perú; I suggest Chachapoyas; ♂; Brussels Mus.

Popelairia tricholopha REICHENBACH, 1854 (March), Jour. f. Ornith., vol. 1, Beilage zu Extraheft, p. 12—"Columbia."

Uchco, 1 ♂; Andoas, 1 ♂, 1 ♀; headwaters of Marañón, "E. Ecuador," 2 [♂], 2 [? ♀].

I can find no distinctions between Peruvian and Colombian birds. Reichenbach's new nomenclature was not an attempt to separate a new form from *popelairii* but merely to alter the name, and his citation of "*Tr. Popelairii* Du Bus 1846" in the synonymy of his *tricholopha* is the only detail that serves to lift his proposal from the category of *nomina nuda*. The reference to his "*Trochilinarum enumeratio*," 1855, page 9, sometimes quoted for "*tricholopha*," is unidentifiable except by the repetition of name used in the previous year's paper. There is no bibliographic reference and no plate number since the plate on which the species is figured had not yet been published.

The type of *popelairii* was procured by Baron Popelaire de Terloo, but I have no information as to the locality in Perú from which it actually came. Since the specimen at hand from Uchco, a few miles from Chachapoyas, indicates the occurrence of the species in that vicinity, I have suggested Chachapoyas as type locality. Other records are from Huambo and Río Cadena, Marcapata District. The latter locality is surprising, being in extreme southeastern Perú, far removed from the northern part of the country where the other records originated. Berlepsch and Stolzmann (1906, *Ornis*, vol. 13, p. 121) note the Río Cadena bird as slightly different from north-Peruvian and Colombian specimens, being a little more bluish on forehead, throat, and belly, and lighter rufous brown on the tibiae. They rightly observe that a series from southern Perú is needed to determine the constancy of these characters.

I have included the specimens from the "headwaters of Marañón" in the Peruvian series, since the Marañón itself does not touch Ecuadorian terrain.

***Lophornis langsdorffi melanosternon* (Gould)**

Gouldia melanosternon GOULD, 1868, Ann. Mag. Nat. Hist., ser. 4, vol. 1, p. 323—Perú (Napo and Pebas mentioned and Ucayali queried); ♂, ♀ in British Museum claimed as "types" [= cotypes].

? *Colibri hirundinaceus* SPIX, 1824, Avium species novae...Brasiliam, vol. 1, p. 80, pl. 81, fig. 2—no locality.

The correct nomenclature of this western form is open to question. All authors I have consulted agree in accepting *melanosternon* (or its emendation, *melanosternum*) for this bird and placing Spix's *hirundinaceus* as a synonym of Temminck's *langsdorffi*. Spix (*loc. cit.*) described his *hirundinaceus* as differing from Temminck's bird ("Temminck [sic.], pl. 66, fig. 1") by lacking the purple band across the breast, which is the exact character of "*melanosternon*." Unfortunately, Spix's plate shows a definite purplish area on the side of the breast behind the gorget, giving more resemblance to *langsdorffi* than to the western form. How much reliance to place on the plate is doubtful, since different copies are said to show considerable variation in coloration (Hellmayr, 1905, Abhandl. K. Bayerischen Akad. Wiss., 2 Kl., vol. 22, pt. 3, p. 565). The type was lost long ago, and Spix gives no locality where it was collected, and since he traveled as far up the Amazon as Tabatinga, as well as through the range of *langsdorffi*, it is impossible to say where he secured his specimen. Some poorly prepared skins of *langsdorffi* show only traces of the post-gular band, and Spix's example may have been in poor condition. At any rate, in spite of some possibility that *hirundinaceus* belongs here, there is enough uncertainty to make me unwilling to upset the existing nomenclature by the adoption of Spix's name instead of Gould's.

Pelzeln (1868, Zur Ornithologie Brasiliens, p. 32) recorded two specimens of "*Langsdorffi*" from Ribeirão, Rio Madeira, a record which Hellmayr (1910, Novitates Zool., vol. 17, p. 377) tentatively assigned to *melanosternon*. There are no other records of the species from south of the Amazon until the Río Huallaga is passed to the westward. The Ribeirão specimen is lost and there is, therefore, no assurance that it belonged to the western form.

Melanosternon occurs, however, well beyond its originally assigned Peruvian range, extending northeastward to the upper Rio Negro in Brazil and the Casiquiare in southern Venezuela. Although most of the material I have from this unexpected area consists of females and immature males, there are two adult males and one nearly adult example that enable comparison with the Peruvian specimens. I can find no distinctions in the combined series other than those of age and sex. The band across the breast of the adult males is the same in all, slightly more yellowish green than the rest of the gorget when examined in certain directions of the light, but easily overlooked.

The series of sexed specimens has given an opportunity to clarify the differences between females and young males which resemble each other in so many respects that they have sometimes been confused. In relatively early stages, both sexes have the throat and lower breast sooty black, extending down the middle of the belly, with a broad whitish patch on either side of the lower abdomen; the sides of the breast are somewhat greenish, tending to cross the breast; and there is a broad white patch in the malar region on each side of the throat. The tail is different in the two sexes. In the female the tail is relatively short, about 20 mm. in length; the rectrices are rounded at the tip, with a white terminal spot on each of them, broadest on the outermost pair; the median rectrices are about three-fifths the length of the tail, and the third pair (from outside) are nearly as long as the subexternal pair. In the young males, the tail is longer, from 24 to 29 mm.; the rectrices are more slender, with broad white tips only on outermost pair though sometimes with fine pale dots on others; terminal outline of three middle pairs usually acute; median pair less than half the length of the tail and third pair noticeably shorter than the subexternal ones.

The adult females appear to retain a considerable part of the white malar stripe and to acquire a definite glittering green area on the lower throat and breast, sometimes with a trace of green on the sooty upper throat; the flank patches remain white. The young males lose the white malar patches and the whole throat and breast become glittering green; the flank patches become smoky gray; and at the last the tail develops the long filiform plumes, beginning with the outermost rectrices.

Gould, in listing his material for the original description, stated that he had numerous specimens, including three males, one of

which was from the Napo, one from Pebas, and one possibly from the Ucayali. The Ucayali record needs confirmation, but the other two are authentic. In addition, there are records from Yurimaguas, Jeberos, and Chayavitas, from which last locality I have a single specimen. The Pebas skins listed below were collected by Hauxwell who obtained Gould's cotypes. They are possibly paratypes although this is impossible to ascertain.

SPECIMENS EXAMINED

L. l. langsdorffi.—

BRAZIL:

“Rio de Janeiro” trade-skins, 12 ♂, 1 ♀.

L. l. melanosternon.—

PERÚ:

Pebas, 1 ♂, 1 ♀ ;

mouth of Curaray, 2 ♂, 1 ♀ ;

Apayacu, 1 ♂ ;

Chayavitas, 1 ♂.

BRAZIL:

Rio Negro, Cucuhy, 1 ♂, 1 [♀] ;

Tatú, 3 ♀ ;

Rio Uaupés, Tahuapunto, 1 ♂.

COLOMBIA:

Río Huaynia, junction with Casiquiare, 6 ♂, 4 ♀.

VENEZUELA:

Terrain between junction of Huaynia and Casiquiare, 1 ♀.

Chlorestes notatus puruensis (Riley)

Chlorostilbon puruensis RILEY, 1913 (Mar. 22), Proc. Biol. Soc. Washington, vol. 26, p. 63—“Hyutanihan” [=Hyutanahan], Rio Purús, Brazil; ♂; U. S. Natl. Mus.

The distinction of subspecies in this species is complicated by the fact that the various characters on which separation can be based are not perfectly stable but are variously combined in birds from different parts of the range, including some 240 males, from which certain conclusions may be drawn.

In the Guianas, Venezuela, Colombia, and Trinidad, the adult males almost always have a well-defined violaceous blue patch on the chin, retaining some blue color in all positions of the specimen in which reflection can be observed. The same is true for birds from the Pará region of Brazil southeastward to Bahia. Along the south bank of the Amazon, from the Tocantins westward to the upper Ucayali in Perú, and at Faro and Obidos, north of the lower Amazon, the chin spot is weaker, less extensive and less

well defined, and may lose the blue color in certain positions. On the lower Ucayali and across the Marañón near the mouth of the Río Napo, there is little or no blue observable on the chin in any position. This is the most stable character of any noted.

Average differences are evident in the length of the bill in different regions, but there is too much overlap to utilize the character to any serviceable degree. The birds with the smallest bills are from Bahia; specimens from Pará to Pernambuco average a little longer billed; and Cayenne and Surinam examples are still greater. British Guianan and Orinocan specimens show the largest extremes and the largest averages, but at the minimum are no larger than Cayenne specimens. Lower Amazonian birds average larger than the Cayenne-Bahian series and on the Tocantins and Xingú have a minimum equal to that of the Pará-Pernambuco measurement but a maximum higher than in that series. Westward up the Amazon there is a slight increase in average bill-length without reaching the Orinocan figure. There is no sharp definition anywhere in the entire species.

The general ventral coloration is difficult to appraise owing to the change of color in different positions of the specimen, and an interesting reversal of supposed distinction may occur when the relative positions of two samples are changed. Thus, in a certain position with reference to the light, if a few specimens from one region are placed alongside an equal number from another area, those toward the right end may appear bluer than those to the left, but if the two series are reversed in relative position, the "greener" birds become bluer and vice versa. It is only when the relative greenness and blueness persist, though to a different degree, that one can be sure of the actuality of the distinction.

To recapitulate, with this test applied to the material at hand, the Cayenne and Surinam males appear as relatively greenish on the breast; the Pará to Pernambuco and Bahian birds are more variable and occasionally quite bluish, especially in the unusual and presumably aberrant type of Lawrence's "*subcaerulea*." The series from Trinidad, Venezuela, eastern Colombia, and British Guiana is somewhat more bluish than the Cayenne and Surinam assemblage and shows the bill longer on average though sometimes equally short. All these examples show the well-marked chin-spot mentioned above.

The lower Amazonian series shows somewhat more blue on the breast than the Trinidad-Venezuelan-Colombian-British Guianan

assemblage but has the chin-spot less distinct, and this combination of characters persists as far westward as the upper Ucayali in eastern Perú, although on the lower Rio Madeira and at Tefé there is a tendency toward more greenish ventral coloration. This trend is intensified on the lower Ucayali and north of the Marañón in Perú, where it is pronounced enough to warrant the recognition of a new form described hereunder, but the upper Ucayali birds retain the characters of the lower Amazonian population undiminished.

There is some variation also in the amount of golden reflections on the upper parts, and the few birds at hand from the Bahia region show the maximum amount of this variation. Cayenne and Surinam birds approach them more closely than the average sample from other regions, except perhaps the population at the mouth of the Napo in northeastern Perú. Individual specimens from other regions show the color in varying degree, sometimes fully equal to that of the Bahia birds. The significance therefore is not established.

I am unable to find any good criteria for distinction of females from different regions, except correlation with the lengths of bill exhibited by the males in which there is too much overlap for it to be decisive.

The arrangement that shows the best correlation with geographical distribution and permits the best discrimination of subspecies allows the recognition of typical *notatus* from the Guianas, Venezuela, eastern Colombia, and Trinidad, north of the Amazon, and eastern Brazil from Pará to Bahia; *puruensis* from Faro, Obidos, and the mouth of the Negro, north of the Amazon, and the region south of that stream from the Tocantins west to the upper Ucayali; and a third form, named below, from the lower Ucayali and the mouth of the Napo in Perú.

All but two of the 11 names given to members of this species by different authors, not including Gould's "*Eucephala hypocyanea*" (1860, Proc. Zool. Soc. London, pt. 28, p. 306) which appears to have been based on a specimen of hybrid origin, apply to Cayenne or Bahian birds and hence are not available for the Amazonian population. This applies to "*T. cyanogenys*" Wied (1832, Beiträge zur Naturgeschichte von Brasilien, 1832, vol. 4, pt. 1, p. 70) which has been assigned to this form by some authors. Wied's itinerary embraced parts of the provinces of Rio de Janeiro, Espírito Santo, Minas Gerais, and Bahia, but nowhere approached

the range of the Amazonian form of this species. Of the two specimens (from Barcellos, Rio Negro, Brazil) named *Agyrtria meliphila* by Pelzeln (1868, Zur Ornithologie Brasiliens, pp. 29, 57), their original description consists merely of a comment on their close relationship to "*Agyrtria mellisuga* (Linné)" and the length of the wing as "1" 10-11'", hardly an adequate diagnosis. Simon has identified the female cotype as belonging to the present species; the male cotype is "*Chlorostilbon prasinus*" subsp. under which "*meliphila*" has long been synonymized. The only available name is that given by Riley, cited at the head of this discussion.

I am unable to be sure about the Chamicuros, Yurimaguas, and Shanusi records of this species, since I have no material from that part of Perú. The fact that *puruensis* appears to be restricted to the upper Ucayali while another form occurs lower down and north of the Marañón suggests that these western birds may belong in this second form, next to be discussed. An early record from Yarina Cocha, from which locality I have additional material, belongs with *puruensis*.

Chlorostes notatus obsoletus, new subspecies

TYPE: From Puerto Indiana, mouth of Río Napo, northern Perú. No. 231122, American Museum of Natural History. Adult male collected August 10, 1926, by Carlos Olalla and sons.

DIAGNOSIS: Similar to *C. n. notatus* and *C. n. puruensis* but under parts greener and less bluish than in either of the other forms and blue chin spot very weak or lacking.

RANGE: Northeastern Perú, on the lower Ucayali, in the neighborhood of the mouth of the Napo, and westward, presumably, to the mouth of the Huallaga. Possibly, also, eastern Ecuador.

DESCRIPTION OF TYPE: Upper parts shining dark Grass Green × Parrot Green, approaching Cossack Green on the uropygium and with some coppery reflections on the mantle. Under parts (held away from the light) glittering Emerald Green × Night Green, with a faint bluish tinge at the apex of the chin, and a small white area on the lower belly. Remiges purplish black; upper wing-coverts like the back; under coverts like the breast. Tail steel blue. Maxilla (in dried skin) blackish; mandible dull ivory, with a dark tip; feet blackish. Wing, 52 mm.; tail, 30; culmen, 17; tarsus, 5.

REMARKS: This form is nearly approached by the birds from Tefé, although there is distinction evident there, but in comparison with birds from the upper Ucayali and from the lower Amazon the difference in coloration is quite marked. Specimens from the Rio Madeira also are intermediate, although not so close to *obsoletus* as are the Tefé examples.

A longer series of specimens from the lower Ucayali might show some trend toward *puruensis* at that point, but the two males at hand, one of which is not fully adult, indicate the occurrence of *obsoletus* on both sides of the Marañón.

Most of the specimens of *obsoletus* have the mandible somewhat dusky, less yellowish than the great majority of *notatus* and *puruensis* where this shading appears in relatively few examples, except perhaps in the Trinidad birds where it is not infrequent. Field notes on the labels of the Trinidad birds indicate duller reddish, pink, or flesh color in freshly killed birds of this sort than in those with the lighter mandibles at present. The character is of doubtful taxonomic value.

Records from Pebas, Iquitos, "lower Ucayali," and presumably Chamicuro, Yurimaguas, and Shanusi belong with *obsoletus*.

SPECIMENS EXAMINED

C. n. notatus.—

TRINIDAD:

(Caparo, Chaguaramas, Princetown, Savannah Grande, Valencia, Aripo, and "Trinidad"), 33 ♂, 7 ♀.

VENEZUELA:

(Cristóbal Colón, San Esteban, Caracas, Las Trincheras, and Mérida), 21 ♂, 2 ♀, 1 (?);

(Nericagua, Munduapo, El Llagual, Suapure, Sacupana, La Unión, Paloma Island, La Prisión, and "Orinoco"), 61 ♂, 31 ♀.

COLOMBIA:

Maipures, 9 ♂, 6 ♀.

BRITISH GUIANA:

(Tumatumari, Mines District, Ourumee, Rockstone, upper Mazaruni River, and "Br. Guiana"), 6 ♂, 1 (?).

SURINAM:

(Little Wanica and near Paramaribo), 11 ♂, 2 ♀, 4 (?).

CAYENNE:

(Cayenne and Roche Marie), 6 ♂, 4 ♀.

BRAZIL:

Pará (Utinga and Prata), 5 ♂, 4 ♀;

Maranhão, Miritiba, 1 ♂;

Pernambuco, Palmares, 2 ♂;

Bahia, 5 ♂ (including type of *subcaeruleus*), 3 ♀.

C. n. puruensis.—

BRAZIL:

Obidos, 4 ♂, 1 ♀, 1 (?);

Faro, 5 ♂, 2 ♀;

Rio Negro (Muirapinima and Igarapé Cacao Pereira), 1 ♂, 1 (?);

Rio Tocantins (Baião and Mocajuba), 7 ♂, 2 ♀;

Rio Xingú (Tapará and Porto de Moz), 9 ♂, 1 ♀;

Rio Tapajoz (Tauarý, Piquiatuba, Caxiricatuba, Igarapé Brabo, Igarapé Amorín, and Santarem), 13 ♂, 9 ♀;

Villa Bella Imperatriz, 2 ♂, 1 ♀;

Rio Madeira (Borba, Igarapé Auará, Humaythá, Marmellos, and Rosarinho), 10 ♂, 4 ♀;

Rio Preto, Santa Isabel, 3 ♂, 1 ♀, 2 (?);

Teffé, 6 ♂, 2 ♀.

PERÚ:

Lagarto, 6 ♂;

Yarina Cocha, 2 ♂;

"Ost-Peru," 1 ♂.

C. n. obsoletus.—

PERÚ:

Sarayacu, 2 ♂;

Orosa, 1 ♀;

Río Tapiche, 1 (?);

Río Mazán, 1 ♀;

Puerto Indiana, 19 ♂ (including type), 10 ♀.

A CORRECTION

In No. 54 of the present Studies (1949, Amer. Mus. Novitates, no. 1428, p. 52) I stated that four localities (La Puente, Guainche, Cebollal, and Alamor) appeared to belong to Perú through the boundary treaty between that country and Ecuador. I find that I was in error and that these localities are still in Ecuador. Records there given from these places must, therefore, be deleted from the Peruvian list. Anterior records from Alamor, Perú, are correct and refer to another locality of the same name that is in Perú.

AMERICAN MUSEUM NOVITATES

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A NEW *SIGANUS* FROM THE GREAT BARRIER REEF, AUSTRALIA

BY OTIS BARTON

While taking motion pictures on the Great Barrier Reef, I collected many species of coral reef fishes during the summer of 1947. They were taken on the leeward or northwest side of about a dozen keys in the Cairns-Cooktown region, by means of an improved model of the New York Zoological Society "bang-stick."

One of the most interesting is a small, aberrant, golden-colored, seemingly undescribed *Siganus*, with only 12 dorsal and six anal spines.

Siganus hexacanthus, new species

DESCRIPTION OF TYPE: No. 18888, the American Museum of Natural History, the only specimen, from Lizzard Island, Great Barrier Reef, Australia, July, 1947, collected by Otis Barton.

Length to base of caudal, 53 (total, 66) mm. Dorsal rays, XII, 11; anal, VI, 10. Body oblong, compressed, depth 2.1 in standard length, head, 3.4. Profile from snout to dorsal slightly convex, from chin to ventrals concave. Eye 2.6 in head, 1.2 in snout; maxillary extending to below posterior nostril; width of preorbital at angle of mouth, 2 in snout. Anterior nostril with a triangular, tubular flap; opercle with a blunt spine superiorly. Least depth of caudal peduncle, 3.8 in head.

Head naked, scales beginning at occiput. First dorsal spine a little more than half second in length, third, fourth, and fifth subequal, 1.8 in head, twelfth and last two-thirds as long as first dorsal ray, and 2.7 in head. Middorsal rays longest and equal to longest anal spines. First anal spine two-thirds of second (which is scarcely shorter than third, 1.8 in head), the following five sub-

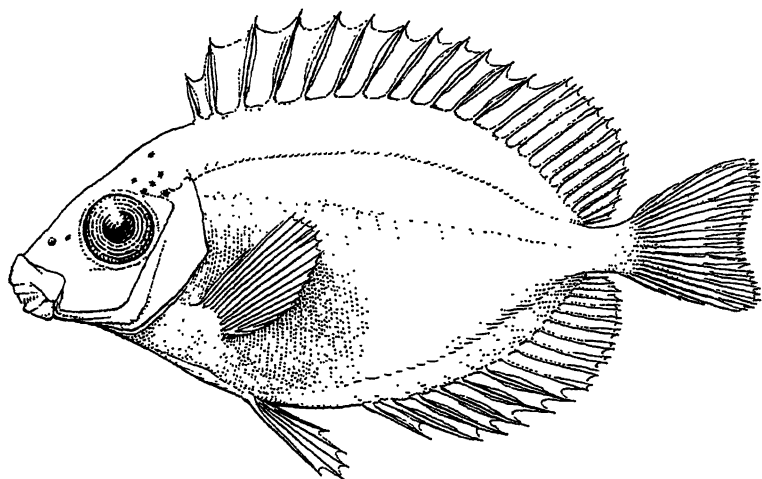


FIG. 1. *Siganus hexacanthus* Barton, type.

equal, 1.7 in head, and a little longer than the first nine anal rays, which are subequal. Caudal lunate, lobes subequal, 1.4 in head; pectorals, 1.3; ventrals, 1.6, and extending almost to first anal spine.

Color in alcohol uniform yellowish brown, fins hyaline; five dark spots about one-fifth the diameter of pupil, behind eye superiorly, above these another similar spot; very faint indications of a diagonal bar below eye; peritoneum dark. Color in life bright golden, without noticeable marking.

Distinguished by reduced number of dorsal and anal spines.

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NEW TRINIDAD MYRMICINAE, WITH A NOTE ON *BASICEROS* SCHULZ (HYMENOPTERA, FORMICIDAE)

BY NEAL A. WEBER¹

Among the ants that I took in Trinidad, British West Indies, in 1934-1935 while a National Research Fellow in Biology at the Imperial College of Tropical Agriculture are several that doubtless belong to the archaic fauna of the island and probably were acquired when it was attached to the mainland. The *Lachnomymex* is the third species of the genus to be described, the first (*scrobiculatus* Wheeler) being known from Guatemala and the second (*haskinsi* M. R. Smith) from Panama. The new genus, *Aspididris*, I have realized to be new for over 10 years, and the fact that it has never been described or taken since (except for one specimen sent to me for identification several years ago) shows it to be a rare and highly localized relict. The Nariva Swamp, in which it was taken in 1935, preserves the rich Neotropical rain forest in excellent condition. It will undoubtedly be found on the mainland. The note on *Basiceros singularis* records this archaic ant from the luxuriant rain forest of the Northern Range in Trinidad, as well as from the virgin, uninhabited rain forest of the upper Courantyne basin of Guiana which contains Amazonian elements.

Lachnomymex pilosus, new species

WORKER: Length extended 3.0 mm., of thorax 0.83 mm. Head in front view, excluding mandibles, slightly longer than broad

¹ Swarthmore College, Swarthmore, Pennsylvania.

back of eyes, occipital margin and sides convex, anterior clypeal margin distinctly emarginate medially; eyes large and convex, situated in front of middle of head; frontal scrobes deep and marginate, not quite receiving the entire length of the scapes; frontal lobes small and obtusely angulate; mandibles triangular, with convex lateral margins, cutting margin with five teeth including the tooth forming the junction between the cutting and basal margins, two apical teeth close together, the median tooth with a wide diastema on either side, the basal pair as close together as the apical pair; antennal scapes short, about 0.46 mm. long, funiculus with two-segmented club about 0.39 mm. long. Thorax globose above, nearly as broad as long between "collar" and meso-epinotal suture; meso-epinotal impression marked; epinotal spines long, straight, and acute, the space between concave; metasternal angles with an acute spine about half the length of the epinotal and of similar proportions. Petiole with distinct pedicel and node, the latter in side view with concave anterior and convex posterior faces meeting as a rounded angle; postpetiole convex above, distinctly broader than petiole. Gaster small and ovate. Legs long and slender.

Head, thorax, and nodes of pedicel deeply sculptured; head longitudinally rugose with punctations basally, mandibles punctate; thorax and nodes vermiculate-reticulate, basally punctate; gaster shining but with a faint, superficial punctation. Pilosity of abundant, long, flexuous hairs on legs and gaster as well as on body generally; funiculi with abundant but short hairs. Color dark ferruginous, appendages including mandibles markedly paler, being more a yellowish brown.

HOLOTYPE (A.M.N.H.): One worker, which I collected in Trinidad, British West Indies, August 5, 1935 (No. 260). The ant was taken on the northwest corner of the island at Macqueripe Bay about 2:30 P.M. It was at the base of a bamboo clump on the south slope of a steep gully, among moist, rotted leaves. The site was largely shaded, receiving sunshine only for several hours at midday. This is also the habitat of *Strumigenys*, certain *Cyphomyrmex* and *Apterostigma* among the Attini, and other ants.

Differing from a cotype of *scrobiculatus* Wheeler especially in finer sculpturing. Differing from the figures of *haskinsi* M. R. Smith in having the terminal antennal joint longer, the thorax more convex above, the petiolar node not excavated behind, and the postpetiolar node more evenly convex. The meso-epinotal

impression is bordered differently. These differences may be expressed in the following key:

1. Sculpturing coarsely rugulose to vermiculate-reticulate, metasternal spines triangular.....*scrobiculatus*
Sculpturing finer.....2
2. Meso-epinotal impression bordered anteriorly on each side by a tubercle, petiolar node impressed behind, metasternal spines triangular....*haskinsi*
Meso-epinotal impression not tuberculate anteriorly, petiolar node convex above, metasternal spines acute, about half the length of the epinotal spines and of similar proportions*pilosus*

ASPIDIDRIS,¹ NEW GENUS

Allied to *Basicros* Schulz.

DEALATE FEMALE: Size moderate. Head shield shaped, with sides and occipital margin raised, the posterior border a convex crest; clypeus large, with transverse anterior margin covering the bases of the mandibles; eyes small, convex, situated at the lateral margins; frontal area raised, frontal carinae distant from one another and continuous with lateral margins; mandibles triangular, dentate, the basal margins covered by the clypeus; antennae 12-segmented, the scape flattened, broad and geniculate at the base, funicular segments short, the terminal segment markedly longer than the segments preceding. Epinotum bispinose or bidentate. Petiole pedunculate, surmounted by a rounded node. Gaster ovate, the anterior margin concave, articulating broadly with the postpetiole. Tibia broad and flattened, tarsi ending in a pair of long claws. Integument punctate, hairs simple to squamate or clavate, becoming long and narrow squamate on the appendages.

WORKER: Similar to female except for reduced ocelli and thoracic sutures.

Aspididris militaris, new species

FEMALE (DEALATE): Length extended 6 mm., of thorax, excluding "neck," 1.7 mm. Head in front view, including mandibles, ovate, greatest width coming at the posterior margin of the antennal scrobes; occipital margin evenly convex and raised as a crest; lateral margins converging sharply anteriorly to the antennal insertions and similarly raised, with a broad, deep, antennal scrobe extending to the occiput; anterior clypeal margin straight

Aspididris, from Greek *aspis*, a shield, and *idris*, the knowing or provident one.

and extending laterally beyond the margins of the mandibles, anterior and lateral clypeal margins forming a rounded right angle, posterior margin convex and attaining a level with the antennal insertions; frontal area raised as a convex eminence extending to the peripheral crest; ocelli vestigial or absent; eyes small, 0.22 mm. in diameter, convex, embedded in the lateral margins; mandibles with only the dentate portion extending beyond the clypeus, this portion bearing 10 or 11 acutely pointed triangular teeth which increase in size distally, the exposed mandible being triangular and curved downwards; antennae 12-segmented, scape strongly and broadly geniculate, occupying entire antennal scrobe and extending to the occipital corners, terminal segment approximately equal in length to the preceding six taken together. Thorax in profile irregularly convex and flattened

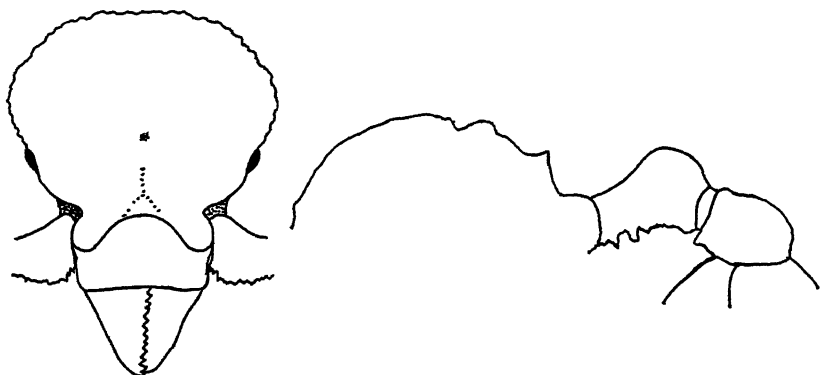


FIG. 1. Left: Frontal view of head of worker of *Aspididris militaris*, new species. Right: Lateral outline of thorax and pedicel of worker of *Aspididris militaris*, new species.

above, from above the sides appear converging from the pronotum posteriorly, the pronotum convex anteriorly; epinotal spines broad and triangular, episternal angles lobate, convex. Petiole pedunculate, in side view with node convex above, ventral margin with a bidentate lamina; postpetiole evenly convex above, nearly 1.5 times broader than petiole, anterior margin truncate, sides and posterior margin convex. Gaster ovate except for broadly concave anterior margin to receive the postpetiole which is broadly articulated with it, posteriorly acutely pointed with fine, exerted sting. Legs of moderate length, tibia stout, broader than femur, tarsi long and thin, terminating in a pair of long, fine claws.

Coarsely punctate, each punctation with a short hair which may be narrow, fine, and appressed or narrow-squamate, longer, and reclinate; abdomen with more numerous shallower and finer punctations, mandibles with finely piligerous punctations; sides of thorax and epinotum becoming smooth and shining ventrally. Posterior margins of head, petiolar nodes, and gastric segments and appendages with numerous reclinate to erect squamate hairs on narrow pedicles; these occur scattered on body generally and may be more clavate than squamate; integument of appendages covered so densely by the hairs as to be largely obscured. Color brownish black, appendages dark brown, pilosity a sordid brownish yellow.

WORKER: Length 5.7 mm., of thorax, excluding neck, 1.6 mm. Ocelli vestigial or absent except for a slight pit marking the anterior ocellus. Thorax with sutures suggesting those of female but in reduced and fused form, especially the promesothoracic sutures.

HOLOTYPE (A.M.N.H.): One dealate female, which I took in the Nariva Swamp, Trinidad, British West Indies, April 23, 1935. It was one of several of the same species that were found slowly stalking over the forest floor. The ants appeared typically basicerotine and dacetine in their gait and behavior, "feigning death" readily when disturbed and appearing practically invisible against humus. Paratypes in the Museum of Comparative Zoölogy and in my collection. The female ocelli are of variable size, attaining a maximum diameter of 0.04 mm. and situated in shallow pits much resembling the piligerous punctations of the head generally. One female (No. 139) has the thorax length, excluding neck, 1.8 mm. A paratype female (No. 140.1) has an oribatid-like mite attached to the left mesothoracic femur.

A NOTE ON *BASICEROS SINGULARIS* F. SMITH

On a brief visit to the British Museum (Natural History) in January, 1948, the ant carrying the type label of this species was examined. The label read: "*Ceratobasis singularis* Sm. type Journ. Ent. 1.78" and was stated by my colleague and keeper of the ant collection, Mr. Donisthorpe, to be in Kirby's writing. Above this was a second label carrying the numbers 59 and 2, 59 referring to the date of accession, 1859. The ant is an alate female *Trachymyrmex*, and there has evidently been a mix-up, perhaps in Kirby's day when he was caring for the collection in the nineteenth century. The specimen is heavily sculptured, is

ferruginous in color, and has the occipital margin emarginate medially; the mandibles are long and falcate; the antennal scapes do not quite reach the occipital angles; there are pronotal tubercles and epinotal spines; the sides of the gaster are marginate, and the gastric tubercles are confluent posteriorly. There is no resemblance to the ant described by Smith.

Ceratobasis of Smith, 1860, is preoccupied by Lacordaire, 1848, and is a synonym of *Basiceros* Schulz, 1906. Smith's *singularis* has been generally recognized by his and other drawings and specimens. I have taken *singularis* workers in the following localities:

Trinidad, British West Indies: Summit of Morne Bleu, 2781 feet, Northern Range (latitude $10^{\circ} 44' N.$, longitude $61^{\circ} 15' W.$) December 2, 1934. From leaves and humus in dense shade under rain forest. This ant is doubtless a part of the ancient fauna of the island and probably restricted to the Northern Range. The species may well have been acquired when the island was connected with the mainland in the geologic past.

British Guiana: Oronoque River of the Courantyne system, July 26 and August 3, 1936. On the former date a worker was walking up an inclined dead log carrying a dead worker termite at 1 P.M. On the latter date a worker, probably of the same colony, was taken at 2 P.M. on the same log. It walked slowly and haltingly, as dacetines generally do, with the antennae much of the time held rigidly and horizontally in front. Between the two dates I had visited the log many times and hacked away much of the rotted wood in search of this and other interesting species but had not detected the nest. The region was one of high, virgin rain forest, uninhabited and characterized by Brazil nut and other trees typical of the Amazon basin, from which watershed it was separated by less than 100 miles.

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REDESCRIPTION OF THE POLYCHAETOUS ANNELID *TYPOSYLLIS ACICULATA* TREADWELL¹

BY DONALD J. REISH

The purpose of this paper is to detail the specific characters of a member of the family Syllidae, *Typosyllis aciculata* Treadwell (1945, pp. 1-2), so as to permit its comparison with some other members of the genus which occur in the same or adjacent geographic areas. Examination of the holotype and paratype specimens reveals that the affinities of the species are with some species that have a widely reported range (see discussion below).

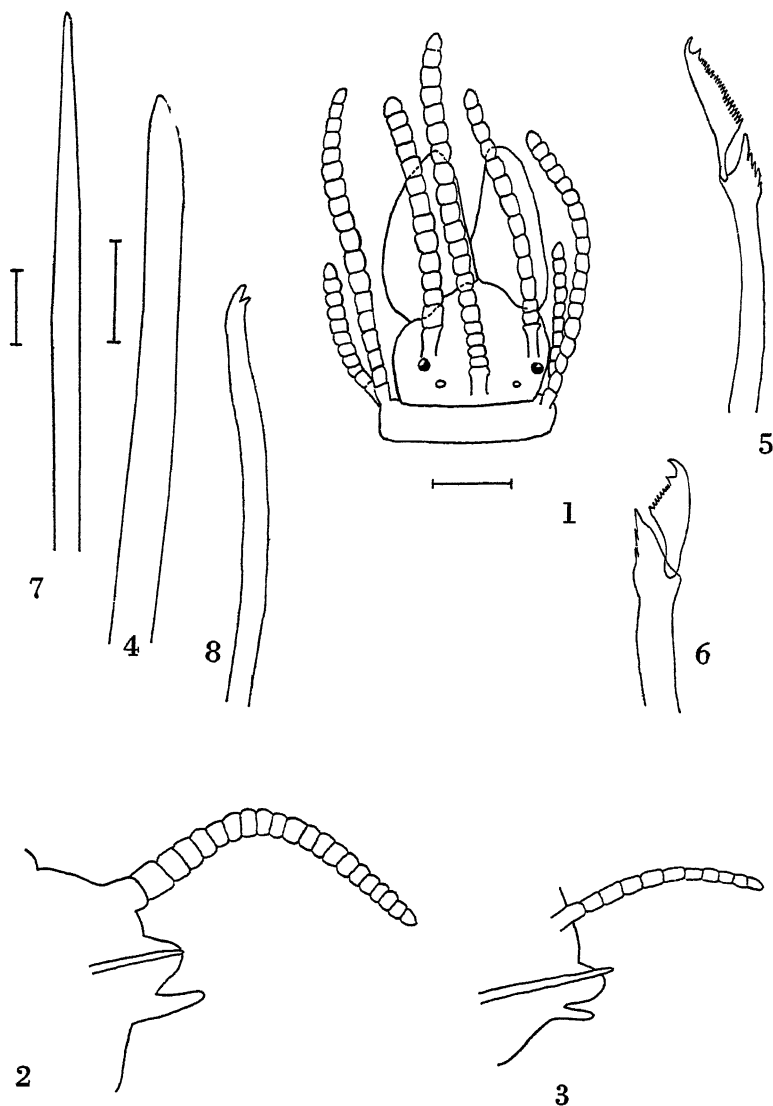
I am indebted to Mr John C. Armstrong, Assistant Curator of Invertebrates, the American Museum of Natural History, for the loan of type materials. This study was conducted at the Allan Hancock Foundation of the University of Southern California; to its administration I acknowledge thanks for the use of material aid.

Typosyllis aciculata Treadwell

DESCRIPTION Two small specimens come from among rocks at Pacific Grove, California, July 19, 1939. The holotype, in two pieces, measures 8.5 mm. in length and 0.65 mm. at its greatest width which is around the twentieth setigerous segment. There are 76 setigerous segments in the holotype and over 80 in the paratype. The paratype lacks a posterior end. The worm is brown, with dark intersegmental furrows.

The prostomium (fig. 1) is pentagonal in shape and slightly

¹ Contribution from the Allan Hancock Foundation, University of Southern California, Los Angeles.



FIGS. 1-8. *Typosyllis aciculata* Treadwell. 1. Anterior end, holotype. Scale: 0.1 mm. 2. Sixteenth parapodium, holotype; six composite setae omitted. Magnification as in figure 1. 3. Sixty-eighth parapodium, holotype; five composite and one simple setae omitted. Magnification as in figure 1. 4. Aciculum from sixty-eighth parapodium, holotype. Scale: 0.03 mm. 5. Superior composite seta from sixty-eighth parapodium, holotype. Magnification as in figure 7. 6. Inferior composite seta from sixty-eighth parapodium, holotype. Magnification as in figure 7. 7. Superior simple seta from sixty-eighth parapodium, holotype. Scale: 0.01 mm. 8. Inferior simple seta from sixty-seventh parapodium, holotype. Magnification as in figure 7.

broadier than long. It bears a pair of palps, three antennae, and two pairs of eyes. The palps are joined at their bases for one-third their length; they are triangular in shape and about twice as long as wide. The median antenna arises behind the midpoint of the posterior eyes. The lateral antennae originate just in front of the anterior pair of eyes. They are articulated, each with a long base and 13 articles. The four eyes are in trapezoidal arrangement with the anterior pair, which are provided with a lens, farther apart and twice as large as the posterior pair.

The peristomium bears two pairs of moniliformed tentacular cirri with the dorsal pair composed of 17 articles and the ventral pair of 10 articles.

The pharynx, which is smooth at its anterior margin, is six segments long and extends from the fourth to the ninth setigerous segment. There is a single, colorless, anterior tooth.

The proventriculus begins at the tenth setigerous, and extends, for eight segments, to the seventeenth segment.

The anterior parapodial lobes are rectangular in shape (fig. 2); each has an articulated dorsal cirrus, a conical lobe with a single, pale yellow aciculum and six to 10 composite setae, and a short, slender, ventral cirrus. The anterior dorsal cirri are composed of 20 to 23 articles.

The posterior parapodia (fig. 3) are smaller in size than those in front, but they are rectangular as are those in front. These posterior lobes have single, large, pale yellow, superior acicula (fig. 4); they have a smooth tip that projects beyond the tissue in the posterior lobes. Acicula in the anterior segments are smaller in size than those in back. There are five to six composite setae in the posterior lobes. The ventral cirrus is short and slender as in the anterior lobes.

The pale yellow compound setae vary little in anterior, middle, and posterior body regions, but within a lobe the appendage in the superior setae (fig. 5) is longer than those inferior (fig. 6). The appendage has an apical and subapical tooth and a number of spinelets along the cutting edge. One side of the shaft bears three or four spines.

There are two kinds of simple setae present in posterior segments. In one the end has an entire tip (fig. 7), and in the other there is a subapical tooth (fig. 8). The entire ones are located just below the aciculum, and the bifid ones are below the com-

posite setae. Both kinds of simple setae were not observed within the same lobe, but since many setae have been broken, it is impossible to determine what the exact condition is. In the holotype no simple setae were observed anterior to segment 68. In the paratype, however, only simple setae with an entire tip occur at least from segment 55, but, as with the holotype, a number of setae have been broken.

There is only one anal cirrus remaining; it is composed of 16 articles.

The holotype is No. 3386 and the paratype is No. 3365 in the collections of the American Museum of Natural History.

REMARKS: In the original account, the palpi were described as asymmetrical and entirely separated at their base. However, in both holotype and paratype specimens one palpus is partially turned under, thus giving it an asymmetrical appearance; actually they are symmetrical. The palpi are fused for one-third their length, as shown in figure 1. Contrary to the first account, the median antenna is present on the holotype. I find the pharynx to begin at the fourth setigerous segment, not the sixth setigerous segment. Figure 2 of the original report is of a median parapodium which was described as being roughly conical in outline and bearing a dorsal cirrus composed of 53 articles. No lobe was observed to have this shape, and no dorsal cirrus was seen with more than 23 articles. In figure 3 of the original account the dorsal surface is down instead of up, as shown by the position of the aciculum. Only simple bifid setae were described in the first report which possibly are the setae represented in figure 8. No simple setae with an entire tip were described.

DISCUSSION: The genus *Typosyllis* Langerhans, 1879, is a large, ill-defined category with many species for which the affinities are poorly understood. As herein defined, I refer to those species that have similar composite setae in all parapodia and that may or may not have simple setae present in posterior lobes. The prostomial antennae and dorsal cirri are jointed and often appear moniliform. The palpi are either well separated or somewhat fused at their bases. The prostomial eyes number usually four in various arrangements. The prostomial antennae consist of a median and a pair of lateral ones that are inserted on the dorsal surface.

In these respects *Typosyllis* Langerhans, with type *T. krohnii*

(Ehlers), comes near *Syllis* Savigny, 1818, with type *S. monilaris* Savigny. As I here interpret the difference, in species of *Typosyllis* Langerhans all parapodia have similar composite setae and, if present, simple setae only in the posterior region; in the species of *Syllis* Savigny, restricted, there are simple setae in the middle or anterior parapodia.

Typosyllis aciculata Treadwell has affinities with *T. variegata* (Grube), *T. krohnii* (Ehlers), and *T. prolifera* (Krohn). It agrees with these species in having composite setae with a sub-apical tooth in all parapodia and simple setae both above and below in the posterior lobes.

Typosyllis aciculata differs notably from these species in the following respects: (1) the number of articles in the dorsal cirri is the same; they do not alternate long and short; (2) the simple setae in *T. aciculata* are entire above and bifid below; in *T. variegata* and *T. prolifera* all simple setae are bifid; in *T. krohnii* the simple setae are as in *T. aciculata*; and (3) the number of articles in the antennae and tentacular cirri in *T. aciculata* is fewer than for the other species (Fauvel, 1923, pp. 259-262).

Typosyllis variegata, *T. prolifera*, and *T. krohnii* have been reported from the European area, but only *T. variegata* has been taken from eastern Pacific waters. Here it is known from the Galápagos Islands and Panama (Monro, 1933, pp. 28-9) and from Acapulco, Mexico (Rioja, 1941, p. 694).

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GEOGRAPHICAL VARIATION AND SUBSPECIATION IN *HELICONIUS* *CHARITONIUS* LINNAEUS (LEPIDOPTERA, NYMPHALIDAE)

BY WILLIAM P. COMSTOCK AND F. MARTIN BROWN

INTRODUCTION

The idea of making a study of *Heliconius charitonius* arose some 10 years ago in conjunction with the study of Antillean butterflies. After some study the endeavor was abandoned for the reason that several of the samples did not seem adequate to permit of justifiable conclusions. It was determined to borrow material from other collections to increase the size of population samples. During this period of abeyance, material came into the American Museum from Mexico and Central and South America in sufficient quantity to provide samples considered to be adequate from these regions. The article, as now drafted, is based upon about twice as much material as originally available. It is prepared upon the same basis of measurement and observation as originally determined upon but with all raw data rechecked for conformity by one author.

The name *charitonia* presents an interesting problem. It was no doubt derived from *Xáριτες*, the Greek name for the Graces whom the Romans called Graciae or Charites. Linnaeus in the twelfth edition of "Systema naturae" (1767, vol. 1, pt. 2, p. 757, no. 65), described "Charithonia." However, in the same volume, in the index, "Nomina Trivialia Papilionum," he gave another reference, "Charitonia 65." This last reference carries the spelling as corrected by Linnaeus. Müller (1774) used the spelling

"Charitonia" without explanation; Linnaeus (1776) used "Papilio charitonia" and in the thirteenth edition of "Systema naturae" (1790) edited by Gmelin, the spelling is "Charitonia." If there should be any question as to the authority for the adoption here of *charitonia*, it may be pointed out that since both spellings are of the same date (p. 757 and index), the first reviser has the task of selecting one or the other; and since it is believed that no such formal selection has been made heretofore, *charitonia* is selected as the proper spelling of the name.

This well-known and widely distributed butterfly, *Heliconius charitoni* (Linnaeus), commonly called the Zebra, has been mentioned casually so many times in the literature that an exhaustive examination of references would be unprofitably time consuming. A taxonomic check was made to verify names and establish the distribution, and such references are to be found in the bibliography.

DISTRIBUTION

Heliconius charitoni is an American butterfly. In South America it is known from northern Peru, Ecuador, Colombia, and western Venezuela. Bates (1862) did not report it from the Amazon; Capronnier (1873) did not list it from Brazil; it is not mentioned by Sepp (1848) or Stoll (1787) from Surinam, but Cramer (1777) figured the species, saying that it came from North and Central America. Godman and Salvin (1879-1901) said that *Heliconius charitoni* did not occur in the Amazon Valley or Guiana but was known throughout Central America from sea level to 5000 feet elevation. The species is apparently common from Panama to northern Mexico, with reports of it from Texas. William D. Field (1938) recorded one specimen from Scott County, Kansas. Also, he reported (letter) specimens from near Brownsville, Texas, April, and Kerrville, south central Texas, July. Ralph L. Chermock (letter) said that *Heliconius* flies around Brownsville, Texas. H. A. Freeman (letter) said that he collected the species in and around Pharr, Texas, but not north of that area, and at Hidalgo, about 11 miles south of Pharr. Most specimens appeared during September, October, November, and in May.

Kaye (1921) did not report the species from Trinidad, or Longstaff (1908) from Tobago; Godman and Salvin (1896) said that *Heliconiinae* are absent in St. Vincent and Grenada; there is no

mention of *Heliconius* by Butler (1901) from St. Lucia or by Lathy (1904) from Dominica. The species is unreported in recent collections from Dominica, according to Lawrence S. Dillon (letter). In the Lesser Antilles, the most southern record is that of George Edwards (1743) from Montserrat, a specimen probably of the race described by Hall (1936) as *punctata* from St. Kitts and Antigua. The species is common in the Virgin Islands, Puerto Rico, Mona Island, Hispaniola, Jamaica, Grand Cayman Island (Carpenter and Lewis, 1943), Isle of Pines (Holland, 1916), Cuba, but Sharpe (1900) did not report *Heliconius* from the Bahamas nor are there any records known.

Heliconius charitonius is a common species in Florida, with records as far north as Gainesville. Boisduval and LeConte (1833) mentioned *charitonius* as rare from Georgia and Florida, and there is a recent record from Valdosta, Georgia, by V. Nabokov and another from Savannah by H. L. King. William D. Field (letter) reported one specimen from Jasper County, South Carolina, November. Holland (1931) said that the species occurred in the Gulf states. Ludwig von Reizenstein (1863) in his interesting little "Catalogue of the Lepidoptera of New Orleans and its vicinity" listed "24. *Heliconia charitonia*, Linn. Rare. Western lake shore."

METHODS OF STUDY

It is obvious from even superficial comparison of specimens representative of different populations that there are differences which can be defined to separate them. The divergence between individuals of a given population are also considerable so that it becomes necessary to find out in what degree one population is similar to or different from another. To accomplish this, a statistical approach based upon the raw data and not upon the methods of quantitative systematics was adopted.

In total, over one thousand specimens (table 1) were studied, from the collection of the American Museum supplemented by loans from other museums and individuals, all later acknowledged. The material was ample to give good samples representative of the diverse populations almost throughout the reported range of the species. There were no specimens from St. Kitts, Antigua, and Montserrat. Seasonal data were excellent, indicating that the butterflies in most of the different population samples were captured in every month of the year. It was thus possible to

TABLE 1
RECORD OF SPECIMENS BY POPULATIONS AND PERIODS OF FLIGHT

	♂	♀	Total	Months
Virgin Is. and Puerto Rico	77	61	138	10
Jamaica	49	28	77	5
Cuba	43	46	89	12
Hispaniola	79	74	153	11
Florida	126	100	226	12
Mexico	85	54	139	12
Central America	37	26	63	12
South America	76	22	98	7
West slope of Andes	22	17	39	2

check for seasonal variations, but this was unproductive, for there was no apparent association of intra-subspecific variability with changes of season.

Two measurements were made on each specimen, usually on the left forewing, with a vernier millimeter caliper read with a hand lens: the length of the forewing from the base to the fullest extent of the outer margin; the width of the yellow band above the inner margin, measured on the left forewing between veins as indicated in figure 1. In table 2, for the lengths of forewing

TABLE 2

RANGES OF LENGTHS OF FOREWINGS OF BOTH SEXES AND AVERAGES (IN MILLIMETERS); RANGES OF WIDTHS OF BANDS AT VEIN Cu_2 OF THE FOREWINGS AND AVERAGES (IN MILLIMETERS)

	Ranges		Averages		Ranges		Averages	
	♂	♀	♂	♀	♂	♀	♂	♀
Virgin Is. and								
Puerto Rico	33.1-44.5	34.0-45.5	37.4	40.2	1.9-3.0	2.0-3.0	2.4	2.5
Jamaica	28.0-40.7	32.0-41.6	35.9	37.0	2.0-3.4	2.4-3.6	2.7	3.0
Cuba	32.0-47.5	32.0-48.2	40.7	41.5	1.9-3.3	1.7-3.3	2.5	2.6
Hispaniola	29.4-46.0	32.4-48.5	38.6	40.8	1.5-2.6	1.4-2.8	2.1	2.2
Florida	25.2-48.5	33.5-50.0	41.6	43.2	1.0-2.9 ¹	1.4-2.4	1.8	1.9
Mexico	31.7-50.2	36.8-49.4	41.5	43.2	1.8-3.0	2.0-3.3	2.3	2.5
Central								
America	31.2-45.3	34.8-47.8	40.3	42.2	1.6-3.0	1.8-3.3	2.4	2.5
South								
America	31.1-43.0	33.6-43.2	37.6	39.7	1.8-2.8	2.1-3.0	2.3	2.4
West slope of								
Andes	29.2-37.3	31.0-41.4	33.8	36.0	2.4-3.7	2.7-4.0	3.0	3.3

¹ One male 2.9 mm., next largest male 2.5 mm., next two males 2.3 mm.

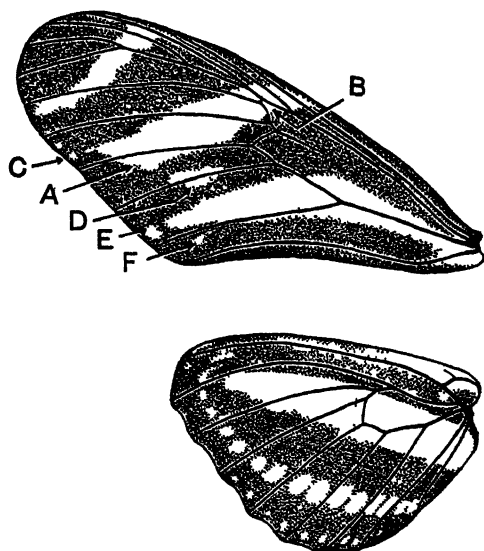


FIG. 1. Enlarged drawing identifying the critical markings of the wings of the left side of the specimen shown in figure 3A

and widths of band, the minimum and maximum lengths and the arithmetical average of all of the specimens of each sample are

TABLE 3

OCCURRENCE OF MACULATION AS INDICATED IN FIGURE 1, BY PERCENTAGES IN VARIOUS POPULATION SAMPLES, PERCENTAGES OF RUSTY FEMALES AND INTERRUPTED BANDS

	A %	B %	C %	D %	E %	F %	Rusty ♀ %	Broken Band %
Virgin Is and Puerto Rico	95 6	56 5	47 2	52 9	99 2	59 4	0	0
Jamaica	48 0	92 3	2 6	6 5	100	31 2	0	0
Cuba	47 2	87 5	34 9	14 6	100	12 4	5 6	0
Hispaniola	44 0	83 0	31 0	3 4	100	15 0	54 0	2 6
Florida	38 8	88 3	30 3	0 4	99 8	0	44 0	90 6
Mexico	15 2	94 0	22 4	1 5	100	1 5	62 0	0
Central America	14 2	77 0	15 8	0	100	3 1	65 3	0
South America	16 3	90 8	9 2	0	92 0	4 1	59 0	0
West slope of Andes	0	100	0	0	100	0	0	0

reported separately for each sex. The widths of bands and lengths of forewing are not in relative agreement in specimens of any population. A wide band does not always occur with a long wing or *vice versa*, but to some extent this is true.

Six characters of the maculation of the upper surface of the forewing were noted for presence or absence. These are indicated on figure 1 as bar (A), an extension of the yellow scaling below vein M_3 ; notch (B), an entry of black scaling into the yellow band at the distal end of the discal cell; spot (C), a small spot of yellow scales at the margin in cell M_2 ; spot (D), a spot of yellow scales lying over vein Cu_1 ; spot (E), a marginal spot of yellow scales in cell Cu_1 ; spot (F), a spot of yellow scales in cell Cu_2 . Table 3 records by percentages the occurrence of these markings in each population sample. These characters are variable in intensity, sometimes prominent, again appearing as traces, but if occurring to any degree they were counted as present. Other variable characters can be found, notably the width of the yellow band of the hind wing, but the characters noted, all on the forewing, are sufficient to define the differences between the various populations.

The following characters were noted for each specimen and tabulated (see tables 1 and 4): the sex; the presence or absence of rusty scales overlying the yellow of the bands and other scale characters such as overlying black scales or replacement of yellow scales by white scales; whether or not the lower yellow band of the forewing was interrupted by patches of black scales on the under surface. The date of capture and locality of each specimen were entered but are not here recorded in detail.

DISCUSSION

The data from the samples show that these represent eight distinct populations of *Heliconius charitonius*. Although no material was available for study, a ninth population is recognized as possibly distinct, that of St. Kitts, Antigua, and Montserrat. These nine populations appear to be in two groups with a connecting population. There are broad, yellow bands on the hind wings associated with short forewings, all from Antillean populations (fig. 3A-C). There are narrow bands on the hind wings mostly associated with long forewings, from Hispaniola, Florida, and the continent (fig. 3E-H). The Cuban population lies between the two groups, for it has broad bands and long forewings

(fig. 3D). The broad bands extend well below the discal cells of the hind wings, while the narrow bands may cut into them, as in the Floridian population, or be but little below them, as in some other populations.

The populations of the various Virgin Islands, Puerto Rico, and Mona Island, hereafter referred to as the Virgin Islands race, show a considerable individual variation between examples in any one locality as judged by the preparatory statistics of the samples. The extensions of the yellow areas (table 3, A, C, D, F) are nearly twice as prominent in examples from the various Virgin Islands as in examples from Puerto Rico. Notwithstanding, the samples from the various areas of the region are preponderantly so similar that there appears to be no basis for a separation of these populations. Relative to other population groups, the Virgin Islands race is small in size, with broad yellow bands on the wings, and the maculation is heavier. The Virgin Islands race is considered to be a distinct subspecies.

The examples of the population of Jamaica are of slightly smaller size than examples of the Virgin Islands race and differ in other characters. The yellow bands are relatively broader, and the band at Cu_2 of the forewing is considerably expanded distad. The yellow spots of the forewing show marked differences from the Virgin Islands race. Spots A and F occur with about half the frequency, notch B occurs with about twice the frequency, and spots C and D are obsolete. Longstaff (1912) in comment said that Jamaican specimens had larger marks as compared with examples from Venezuela. The Jamaican race appears to be a distinct subspecies.

The Cuban population, which is apparently quite uniform throughout the island, stands between the small-sized, broad-banded populations and the large-sized, narrow-banded populations, for it is of large size and broad-banded. The relative occurrence of yellow maculation is shown in table 3 and a racial variation is indicated, but another character appears, that of rusty scales over the yellow in a small percentage of females. This rusty scaling is completely absent in the samples of the previously mentioned races from the Virgin Islands and Jamaica, but it is present in all of the long-winged populations later to be discussed. The Cuban race appears to be a distinct subspecies.

Carpenter and Lewis (1943) reported the species from Grand Cayman as abundant. They noted specimens of large size, some

with "*punctata*" characters. Although no specimens from this locality have been seen, the above remarks suggest that the Grand Cayman population belongs with the Cuban race rather than with the Jamaican.

Holland (1916), reporting the species from the Isle of Pines, was less exact. He said: "They do not differ appreciably from specimens coming from other parts of the Neotropical Region." Without material from the Isle of Pines, its close proximity to Cuba would suggest that its population is probably the same as that of Cuba.

The population in the large island of Hispaniola, with a number of ecologically variable habitats, seems quite uniform judged by the relatively large sample from many localities from end to end of the island. The average size of the specimens of the sample is slightly smaller than of those of the Cuban race, but the width of the band at Cu_2 is distinctly less than in those of the Cuban race. The occurrence of the yellow spots is approximately the same, except that spot D is nearly obsolete. Females with rusty scales increase to over 50 per cent, and another character appears as a trace, that of the interruption of the yellow band with patches of black scales on the under side of the forewing. The Hispaniolan race appears to be a distinct subspecies.

The population of Florida has specimens which are larger in size than those of previously mentioned *Heliconius charitonius* races and also possess the narrowest yellow bands. The considerable series shows a broad range in individual size of examples from 25 mm. to 50 mm., and with the exception of the Mexican sample, the largest average size of any sample. The narrow yellow bands of the forewing are unusual in that in 90 per cent of the specimens, on the under side, the band is interrupted by patches of black scales, often to the extent of completely dividing it. In the Florida race over 40 per cent of the females have rusty scaling, at least to some extent, over the yellow bands. The yellow spot D is obsolete and spot F is absent. The Florida race appears to be a very distinct subspecies.

The five races previously discussed are allopatric, each isolated from the others by marine barriers. There remains for consideration the continental representatives of *charitonius* which range from Peru to the western United States.

The Mexican population represented by a suitable sample, comparable in size to that from Hispaniola, is superficially similar

to that population. Statistically it is quite different. The band at Cu_2 is wider; there is no indication of interruption of the yellow band on the under side by patches of black scales; the yellow spots A and C are considerably reduced, and spots D and F are obsolete. Over 60 per cent of the females have rusty scales, a considerable increase in this character. The Mexican population is sufficiently different from all previously discussed races to be considered a separate subspecies.

Throughout Central America from Guatemala to Panama a sample was examined for comparison with the Mexican sample. The results were slightly different, but it is evident that examples from this region differ little from the population found in Mexico. The slight shift to smaller size and slight differences in maculation may be a clinal trend towards the South American population.

The South American sample includes specimens from western Venezuela, various widespread localities in Colombia, and a lot labeled "Northeastern Peru," perhaps in the lower valley of the Marañon or even the Napo River Valley. This South American sample, although covering a wide area, is quite uniform in its characters. The sample is large enough, although weak in female specimens. It differs from all other samples of populations in that about 25 per cent of the males show more or less black overscaling on the yellow bands. About 60 per cent of the females show rusty scaling; only the Mexican and Central American samples are higher in this character. The average length of the forewing is much less than in the latter samples. As shown by table 3 there are some differences in the percentages of occurrence of the various maculations. The South American race is considered a distinct subspecies.

On the western slope of the Andes there occurs a race of *charitoni*us greatly different from all other populations. This is represented by samples from Lima, Peru, San Rafael, and Guayaquil to Quito, Ecuador. It is the smallest of the races and distinctive in appearance, although the same elements of pattern are preserved. The yellow band at Cu_2 of the forewing is one-third shortened distally and broadest at the point of measurement of any of the races. The yellow band of the hind wing is narrow, as in other continental races. Usually these bands are yellow throughout, but five females have white distal extremities to these bands. The middle band of the forewing is yellow in about half of the specimens, otherwise white. All other maculation, nor-

mally yellow in *charitonius*, is white, producing a strikingly different subspecies.

From table 4 it can be noted that occasionally a male occurs with rusty scaling and that black overscaling occurs rarely in both sexes in other than the South American sample. Albinism, pronounced in the race of the western slope of the Andes, is also noted in other races sparingly in both sexes, being partial in all except for one male from Florida where the yellow coloring on both surfaces is completely replaced by white.

TABLE 4
MISCELLANEOUS DATA ON SCALE COLOR

	Rusty	Black Scales		White Scales	
	♂	♂	♀	♂	♀
Virgin Is. and Puerto Rico	1	0	0	0	0
Jamaica	1	0	0	0	0
Cuba	0	0	0	1	0
Hispaniola	1	2	0	0	1
Florida	0	0	2	4 ^a	0
Mexico	1	0	0	0	0
Central America	1	0	0	0	0
South America	0	20	0	1	0
West slope of Andes	0	9	4	22	17

^a One male completely white, three males with some white scales.

TAXONOMY

Heliconius charitonius charitonius (Linnaeus)

Papilio charithonia LINNAEUS, 1767, p. 757. "America."

Papilio charitonia LINNAEUS, 1767, index.

The male type of *charitonia* is in the collection of the Linnaean Society of London and is illustrated in figure 2. With the type known, it is possible by elimination to fix its place of origin with reasonable accuracy. The type definitely belongs to the Virgin Islands race, and it probably came from the island of St. Thomas, Virgin Islands. This was discussed by Comstock (1944) where it was pointed out that Linnaeus included by reference a specimen from Montserrat (Edwards, 1746, p. 80, pl. 80) and a specimen from Jamaica (Sloane, 1725, p. 217, pl. 239, figs. 15, 16). Both of these specimens and the type specimen of *charitonius* belong to the small-sized, narrow-banded, Antillean group. At that time (1944) this group was not studied fully, and only the

St. Kitts population, named *punctata* by Hall, was separated. Now the populations of the islands of St. Croix, St. Thomas, St. John, and Tortola in the Virgin Islands, Puerto Rico, and Mona Island are included as belonging to the nominate subspecies, *Heliconius charitonius charitonius* (Linnaeus). In these populations about 40 per cent of the specimens from the Virgin Islands show the macular characters of *punctatus*. In Puerto Rico these characters appear, at least to some extent, in 25 per cent of the specimens. Figure 3A shows a specimen from St. Thomas which has the typical maculation of *charitonius punctatus* while figure 3B, also from St. Thomas, is typical of *charitonius charitonius*.



FIG. 2. The Linnaean type of "Charithonia," a male, in the collection of the Linnaean Society of London, photographed by Mr. Cyril F. dos Passos.

Heliconius charitonius punctatus Hall

Heliconius charithonia punctata HALL, 1936, p. 276. St. Kitts.

Hall said in his description: "♂ ♀ Differs from the widely distributed typical race in the presence of an additional yellow spot in cellule 3 [lying on vein Cu_1] of the forewings. This spot varies from a mere dot to a maximum length of 8 mm. and breadth of 2 mm., and is only absent in one out of nearly a hundred specimens captured. There is also a tendency for the oblique discal

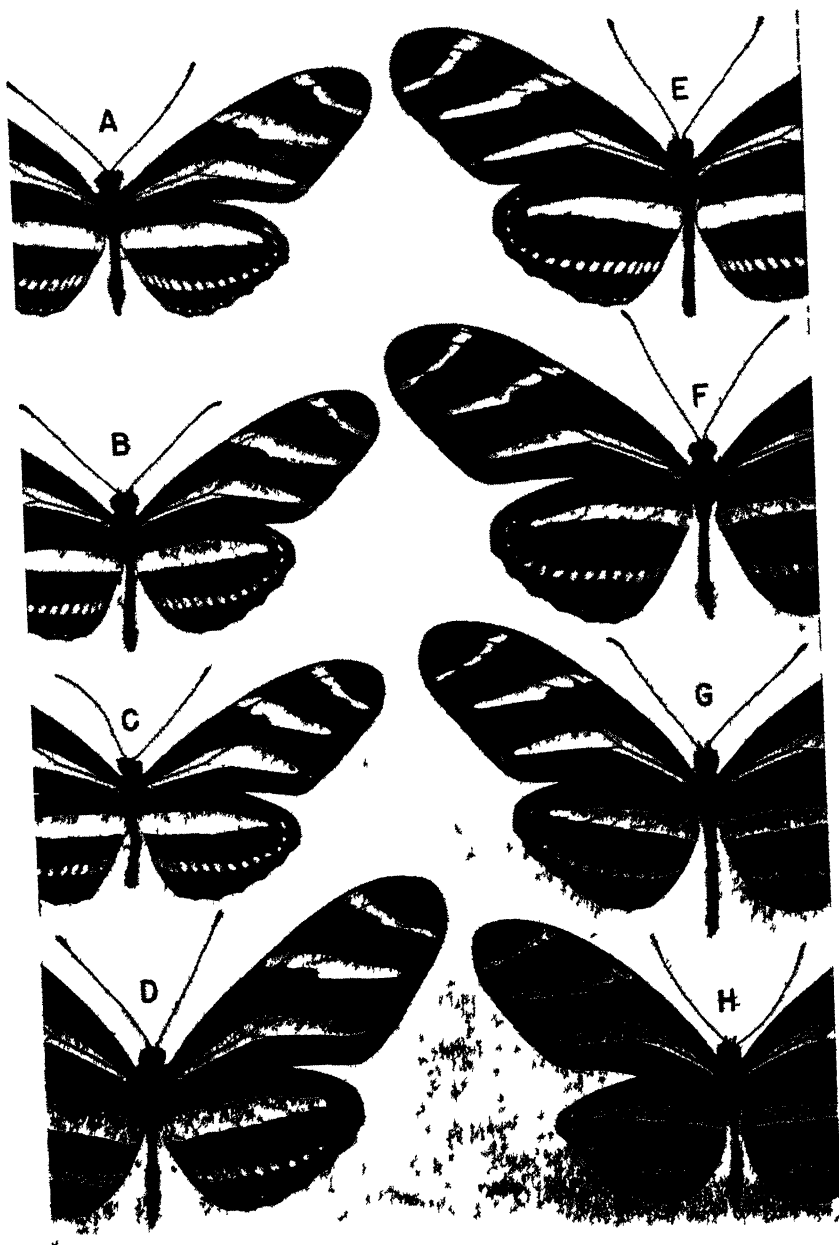


FIG. 3 Left, broad-banded Antillean races Right, narrow-banded races.
(Explanation on opposite page)

band to extend slightly below vein 4 [M_3], and there is a marginal dot above the end of that vein and an additional dot below the distal end of the long basal stripe.

"Habitat.—St. Kitts; a long series.

"Antigua, 1 ♀ in the British Museum."

With no material for examination, Hall's definition of this subspecies is accepted, and Montserrat is added to his localities on the basis of Edwards's (1746) figure.

The genetic influence producing heavy maculation seems to be dominant in the southern Antillean range of the species for, as noted above, it is much in evidence in the Virgin Islands but less so in Puerto Rico. In Jamaica this influence is reduced particularly in the loss of spots C and D. In Cuba spots C and D are much more prevalent, and in Hispaniola spot C appears in about one-third of the examples, with spot D obsolete.

Heliconius charitonius simulator Röber

Heliconius simulator RÖBER, 1921, p. 4. Jamaica.

Röber described this Jamaican race as a new "Art oder Form" from one female from Jamaica. He compared his specimen with 14 specimens from the Cauca Valley in Colombia, a quite different population but not, as he assumed, representative of nominate

EXPLANATION OF FIGURE 3

A. *Heliconius charitonius charitonius* (Linnaeus). Male. St. Thomas, Virgin Islands, November 23, 1925. This specimen shows the characteristics of *Heliconius charitonius punctatus* Hall.

B. *Heliconius charitonius charitonius* (Linnaeus). Male. Charlotte Amalie, St. Thomas, Virgin Islands, March 14, 1929. F. M. Brown, collector. This specimen is probably topotypical.

C. *Heliconius charitonius simulator* Röber. Male. Montego Bay, Jamaica, December 10, 1938. F. E. Church, collector.

D. *Heliconius charitonius ramsdeni*, new subspecies. Paratype, male. Palmarito, Oriente, Cuba. July, 1926.

E. *Heliconius charitonius churchi*, new subspecies. Paratype, male. Port-au-Prince, Haiti, February 8, 1933. H. W. Schroeter, collector.

F. *Heliconius charitonius tuckeri*, new subspecies. Paratype, female. Florida City, Florida, April 5, 1938. Mrs. L. E. Forsyth, collector.

G. *Heliconius charitonius vazquezae*, new subspecies. Paratype, male. Pajaritos, Vera Cruz, Mexico, August, 1944. M. Guerra, collector.

H. *Heliconius charitonius bassleri*, new subspecies. Paratype, male. North-eastern Peru. H. Bassler, collector.

charitonius. The characteristics of *simulator*, previously discussed, are defined in tables 1 to 4, under Jamaica.

***Heliconius charitonius ramsdeni*, new subspecies**

HOLOTYPE, MALE: Matanzas, Cuba, August; Wm. Schaus, collector.

Length of left forewing, 41.2 mm.; width of band at vein Cu_2 , 2.5 mm.; width of band of hind wing, 3.4 mm. Notch B present; spot C, trace; spot E present. The size is slightly larger than the arithmetical average for males of the Cuban population sample but less than the maximum size; the width of the band at Cu_2 is slightly less than the arithmetical average for males but much greater than the minimum width. The markings fall within the range for specimens of the Cuban population.

ALLOTYPE, FEMALE: San Carlos Estate, Guantanamo, Cuba, June 17; the American Museum of Natural History expedition.

Length of left forewing, 44.6 mm.; width of band at vein Cu_2 , 3.0 mm.; width of band of hind wing, 3.8 mm. Bar A present; notch B present; spot D, trace; spot E present; spot F, trace. The size is larger than the arithmetical average for females of the Cuban population sample but less than the maximum size; the width of the band at Cu_2 is greater than the arithmetical average for females but less than the maximum width. The markings approach the maximum but fall within the range for specimens from the Cuban population.

PARATYPES: Forty-two males and 45 females, all from Cuba, coming within the range of the characteristics as tabulated in tables 1 to 4, under Cuba.

Named for Dr. Charles Theodore Ramsden, student of the fauna of Cuba.

***Heliconius charitonius churchi*, new subspecies**

HOLOTYPE, MALE: Port-au-Prince, Haiti, December 30-31; the American Museum of Natural History expedition.

Length of left forewing, 38.7 mm.; width of band at vein Cu_2 , 2.2 mm.; width of band of hind wing, 2.6 mm. Notch B present; spot C, trace; spot E present. The size is about the same as the arithmetical average for males of the population sample from Hispaniola; the width of the band at Cu_2 is slightly greater than the arithmetical average for males. The markings fall within the range for specimens of the Hispaniolan population.

ALLOTYPE, FEMALE: Sanchez, Dominican Republic, June 24 to July 4; the American Museum of Natural History expedition.

Length of left forewing, 43.0 mm.; width of band at vein Cu_2 , 2.1 mm.; width of band of hind wing, 2.8 mm. Bar A, trace; notch B present; spot C, trace; spot E present; yellow bands mostly overlain with scales of rusty color. The size is slightly greater than the arithmetical average for females of the population sample from Hispaniola; the width of the band at Cu_2 is slightly less than the arithmetical average. The markings approach the maximum but fall within the range for specimens of the Hispaniolan population.

PARATYPES: Seventy-eight males and 73 females, all from Hispaniola, coming within the range of the characteristics as tabulated in tables 1 to 4, under Hispaniola.

Named for Mr. Frederic E. Church, artist and collector of Heliconiinae.

Heliconius charitonius tuckeri, new subspecies

HOLOTYPE, MALE: Winter Park, Florida, October 4; A. B. Klots, collector.

Length of left forewing, 41.2 mm.; width of band at vein Cu_2 , 1.5 mm.; width of band of hind wing, 2.6 mm. Notch B, trace; spot E present; yellow band at Cu_2 interrupted by black scaling completely on under side and partly so on upper side. The size is approximately at the arithmetical average for males of the population sample from Florida; the width of the band at Cu_2 is somewhat less than the arithmetical average. The markings fall within the range for specimens of the Floridian population.

ALLOTYPE, FEMALE: Key Largo, Florida, July 15; A. B. Klots, collector.

Length of left forewing, 43.2 mm.; width of band at vein Cu_2 , 1.6 mm.; width of band of hind wing, 2.0 mm. Bar A, trace; notch B present; spot E present; yellow band at Cu_2 interrupted by black scaling slightly on under side; yellow bands partly overlain with scales of rusty color. The size agrees with the arithmetical average for females of the population sample from Florida; the width of the band at Cu_2 is near the minimum. The markings fall within the range for specimens of the Floridian population.

PARATYPES: One hundred and twenty-five males and 99 females,

all from Florida and Georgia, coming within the range of the characteristics as tabulated in tables 1 to 4, under Florida.

This subspecies was named at the request of Dr. Alexander B. Klots for the Reverend and Mrs. Royal Tucker of Winter Park and Crescent City, Florida, because of their hospitality to a working entomologist.

***Heliconius charitonius vazquezae*, new subspecies**

HOLOTYPE, MALE: Campeche, Campeche, Mexico, November; M. Guerra, collector; Frank Johnson, donor.

Length of left forewing, 41.5 mm.; width of band at vein Cu_2 , 2.4 mm.; width of band of hind wing, 3.0 mm. Notch B present, spot E present. The size is at the arithmetical average for males of the population sample from Mexico; the width of the band at Cu_2 is slightly greater than the arithmetical average. The markings fall within the range for specimens of the Mexican population.

ALLOTYPE, FEMALE: Allende, Vera Cruz, Mexico, July; M. Guerra, collector; Frank Johnson, donor.

Length of left forewing, 46.5 mm.; width of band at vein Cu_2 , 2.8 mm.; width of band of hind wing, 3.3 mm. Bar A, trace; notch B present; spot E present; yellow bands moderately overlain with scales of rusty color. The size is about halfway between the arithmetical average and the maximum size for females of the population sample from Mexico; the width of the band at Cu_2 is somewhat greater than the arithmetical average. The markings fall within the range for specimens of the Mexican population.

PARATYPES: Eighty-four males and 53 females, all from Mexico and Texas, coming within the range of the characteristics as tabulated in tables 1 to 4, under Mexico. The three Texas specimens are: one male, Sarita, Willacy County; one female, Corpus Christi, Nueces County; one female, New Braunfels, Comal County.

Named for Miss Leonila Vázquez G., student of the Lepidoptera of Mexico.

***Heliconius charitonius bassleri*, new subspecies**

HOLOTYPE, MALE: La Providencia, Carretera al Mar, Cauca, Colombia, 1300 meters, September; K. von Sneidern, collector; Frank Johnson, donor.

Length of left forewing, 38.4 mm.; width of band at vein Cu_2 , 2.3 mm.; width of band of hind wing, 2.5 mm. Notch B present;

spot E present; yellow bands moderately overlain with scales of black or dark brown color. The size is slightly greater than the arithmetical average for males of the population sample from South America; the width of the band at Cu_2 is slightly greater than the arithmetical average. The markings fall within the range for specimens of the South American population.

ALLOTYPE, FEMALE: Río Cocorna, Antioquia, Colombia, 800 to 1100 meters, August; L. Richter, collector; Frank Johnson, donor.

Length of left forewing, 42.0 mm.; width of band at vein Cu_2 , 2.5 mm.; width of band of hind wing, 2.7 mm. Notch B, trace; spot E present; yellow bands heavily overlain with scales of rusty color. The size is slightly less than the maximum for females of the population sample from South America; the width of the band at Cu_2 is slightly greater than the arithmetical average. The markings fall within the range for specimens of the South American population.

PARATYPES: Seventy-five males and 21 females, all from northwestern South America, coming within the range of the characteristics as tabulated in tables 1 to 4, under South America.

Named for the late Dr. Harvey Bassler, Research Associate, the American Museum of Natural History.

***Heliconius charitonius peruvianus* C and R. Felder**

Heliconia peruviana C AND R FELDER, 1859, p 396 Peru.

The authors said that they received a pair of this species from Peru, noting that it was related to *charitonius*. Apparently, from recent records, this subspecies occurs in the coastal strip west of the Andes. Its characteristics have been defined previously and are summarized in tables 1 to 4.

GENITALIA

Eltringham (1916) considered the classification of the genus *Heliconius* from an examination of the male genitalia, especially the claspers of the male organs. His figures were not particularly informative except for the differentiation of groups. This pioneer attempt is mainly indicative of the need of further intensive study of this apparently complex group of butterflies from the standpoint of structure.

For the purposes of this paper, to satisfy the query as to the specific uniformity of *charitonius*, genitalic preparations were

made of all the subspecies except *punctatus*. All preparations showed consistent uniformity of structure. Preparations of *Heliconius charitonius peruvianus* C. and R. Felder were indistinguishable from those of any other subspecies of *charitonius*. An examination of some of the red-banded species of *Heliconius* showed characters of genital structure which were abundantly distinct.

ACKNOWLEDGMENTS

To obtain satisfactory results from a study of the kind undertaken, it was desirable, in fact necessary, to have reasonably large samples of each population for examination. To accomplish this end and thus supplement the American Museum series, loans were obtained from several institutions and from a number of private collections.

From the Museum of Comparative Zoölogy at Harvard College, through the courtesy of Mr. V. Nabokov, good samples were obtained from Jamaica, Hispaniola, and particularly Cuba, with a scattering of others—a total of 134 specimens.

The Reading Public Museum and Art Gallery, through the courtesy of Mr. Lawrence S. Dillon, lent a total of 57 specimens from five different populations, providing particularly useful series from the Virgin Islands and Central America.

Cornell University, Department of Entomology, through the courtesy of Dr. W. T. M. Forbes, lent specimens from St. Croix, Virgin Islands, and a good series of *peruvianus* from Lima, Peru—a total of 55 specimens.

From the Department of Biology of the Agricultural and Mechanical College of Texas, through the courtesy of Mr. Lawrence S. Dillon, nine specimens were lent, including three captured in Texas.

Of the loans from private collections, that from Mr. F. E. Church was the most varied, containing examples from six populations in a total of 39 specimens.

Examples from Florida were lent by Mr. Otto Buchholz, 12 specimens; Dr. Ralph L. Chermock, 29 specimens; Mr. Cyril F. dos Passos, 42 specimens; Dr. Alexander B. Klots, 49 specimens.

Through correspondence, assistance is acknowledged from Messrs. Ralph L. Chermock, Austin H. Clark, Lawrence S. Dillon,

William D. Field, Wm. T. M. Forbes, H. A. Freeman, V. Nabokov, and Don B. Stallings.

The holotypes and allotypes of the new subspecies are in the collection of the American Museum of Natural History. The remaining specimens of each sample, where they are new subspecies, are made paratypes. All specimens used in this study have printed determination labels affixed.

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(See Cramer and Stoll.)

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A REVISION OF THE GEOMETRID GENUS *SERICOSEMA* (LEPIDOPTERA)

BY FREDERICK H. RINDGE¹

The genus *Sericosema* Warren forms a small homogeneous group in the subfamily Ennominae. There has been little trouble in the past in properly associating the moths with this genus; the difficulties have arisen in the correct application of the specific and subspecific names. This has been due to the great similarity in external structural details of the adults, and in the remarkable uniformity in all species of the color and pattern of both the superior and inferior surfaces of the wings. The problem is quite a difficult one until the genitalic structures are studied; both sexes offer good characters for differentiation of the species, although the male is the better of the two. However, much work still remains to be done with this genus, on both the specific and subspecific levels. There is a particular need for life history work and a careful comparison of the eggs, caterpillars, and pupae to ascertain what differences occur between and within the species of this genus.

MATERIALS STUDIED: Over 850 specimens have been studied, including all the types. This material has been made available to the author through the kindness of the authorities in some of the major eastern and western museums, and the cooperation of several private collectors; these are referred to specifically in the following paragraph. A large number of genitalic slides have been prepared by the author, mainly from specimens in the collection of the American Museum of Natural History and in his personal collection, and additional slides have been examined at the United

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States National Museum and Museum of Comparative Zoölogy, Harvard University; these have served as the basis for the genitalic descriptions and drawings.

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GENUS **SERICOSEMA** WARREN

Sericosema WARREN, 1895, Novitates Zool., vol. 2, p. 131. BARNES AND McDUNNOUGH, 1917, Check list, p. 115. CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 151.

Euemera HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 340.

Head, front slightly protuberant, rounded, long scaled ventrally; eyes large, round; antennae of male bipectinate, plumose, pectinations arising in central region of segments, terminating before apex, of female simple; tongue present; labial palpi strongly developed, heavily scaled, middle segment extending beyond front, terminal segment subequal to length of eyes. Thorax without tufts; legs without hair pencils, fore tibia with moderate process, hind tibia not dilated, with two pairs of spurs. Abdomen without tufts, tending to be laterally compressed. Forewings broad, apex somewhat produced, 12 veins, no areoles; R_1 from top of cell; R_2 to R_5 stalked, from top near upper angle, R_5 from stalk before R_2 ; M_1 from upper angle; M_2 from just above middle of DC; Cu_2 from well before outer angle; fovea absent. Hind wings broad; frenulum strong in both sexes; outer margin slightly concave between veins; Sc approximate to R near base for one-fourth length of cell; R and M_1 approximate, from cell, the latter from upper

angle; DC oblique; M_3 from angle, approximate with Cu_1 at base; Cu_2 from well before outer angle. Forewings and hind wings concolorous light gray brown to tawny; primaries above with t. a. line absent, rarely vaguely indicated on costa, median line absent, t. p. line often prominent, subterminal area sometimes broadly suffused, discal dots absent; secondaries without cross lines, sometimes maculation of under side showing through, discal dots usually absent, rarely faintly indicated. Beneath similar to upper surfaces, usually more strongly marked, discal dots present on all wings, secondaries usually with extra-discal line.

MALE GENITALIA: Uncus long, simple, strongly curved dorsally, bent towards left side medially, recurved apically, sparsely haired, apex with small spine; socius fairly strong, with from 10 to 30 hairs; gnathos rudimentary, represented by rudimentary ring below the socii; valves sclerotized basally, costal region with sclerotized arm at or near base, symmetrical or asymmetrical, terminating in smaller sclerotized arm, valve distal to this second arm not heavily sclerotized; transtilla strongly developed, continued posteroventrally as hood-shaped apparatus; cristae present; juxta broadest anteriorly, elongate, in form of calcar; furca absent; saccus projecting short distance beyond base of valves, bluntly pointed or rounded, subequal to length of uncus; aedeagus elongate, longer than combined length of tegumen and saccus, slender, tapering to point posteriorly on ventral surface, vesica armed with group of elongate longitudinal spines two-fifths to three-fourths length of aedeagus, with one group of short transverse spines medially, another group of short longitudinal spines terminally, these latter two groups sometimes contiguous or absent. Ventral surface of eighth abdominal segment without plate.

FEMALE GENITALIA: Ostium simple; operculum absent; ductus bursae membranous or sclerotized, subequal in length to length of apophyses of ovipositor; ductus seminalis from sclerotized swelling or protruding lip on ventral portion of ductus bursae near ostium; bursa copulatrix membranous, shorter than ductus bursae, with large discoid stellate signum. Segment VII of female abdomen ranging in length from subequal to twice length of segment VI; apophyses of segment VIII correspondingly ranging in length from one-half to equal that of segment VII; segment VII posteriorly and segment VIII ventrally often with elongate scales; ovipositor lobes pointed, convex.

EARLY STAGES: Described by Dyar for *juturnaria*, the only species of which the early stages are known. He reports that the eggs are laid loose, supposedly being scattered over the ground by the moths, and that this species overwinters in this stage. Some eggs are preserved on cards in the National Museum collection; also, one empty pupal case is there. These, plus Dyar's descriptions for the eggs, have been used in the following descriptions. When fresh material becomes available it may be necessary to amend the following and to add more details.

EGGS: Elliptical, micropylar end roundly truncate, the other abruptly rounded; upper surface with single, rather deep median groove, lower surface with two grooves; surface with numerous longitudinal ridges and diffuse transverse ridges, forming squares. Color green, turning dull pink.

LARVAE: No material available.

PUPAE: Shiny brown, in slight cocoon, underground. Head, antennae extending caudad of other appendages, slightly longer than wing cases; labial palpi small, triangular; maxillae slightly shorter than wing cases. Thorax, mesothoracic wings extending to posterior portion of fourth abdominal segment; metathoracic wings narrowly exposed to posterior half of fourth abdominal segment; prothoracic legs approximately three-fourths length of maxillae, femora exposed for relatively long distance; mesothoracic legs subequal in length to maxillae; metathoracic legs not exposed. Abdomen, spiracles without furrows; constriction present between segments IV and V, the surface of segments posterior to this somewhat more pitted than anterior ones; dorsum with distinct furrow between segments IX and X, scalloped on posterior margin; furrow present on lateral surface of segment X; cremaster apparently of six recurved spines, the terminal two much thickened and united basally, much longer than remaining four.

GENOTYPE: *Selidosema juturnaria* Guenée, for both *Sericosema* and *Euemera*; both by original designation.

This genus is apparently most closely related to *Syrrhodia* Hübner (*Catopyrrha* Hübner). These two groups are easily separable by maculation, as the species of *Sericosema* have the wings above and below a unicolorous and somewhat drab light gray brown or tawny with at most a single extra-discal cross line. On the other hand, the wings of the species of *Syrrhodia* vary from bright yellow through olivaceous to green and brown, often being

brightly marked with reddish below, and with several cross lines. Structurally, the two genera are easily separated by the nature of the branching of veins R_2 and R_5 of the forewings: in *Syrrhodia*, R_2 branches from the stalk before R_5 , while in *Sericosema*, R_5 comes from the stalk before R_2 . The genitalia show a fairly close relationship. In the male, both genera have the uncus strongly developed, a rudimentary gnathos, the valves with strongly developed costal arms, a well-developed transtilla, and an elongate aedeagus. The two genera can be easily distinguished from each other by the armature of the aedeagus, *Sericosema* having the vesica armed with a number of spines, whereas in *Syrrhodia* the vesica is either unarmed or has a scobinate patch. The female genitalia may be immediately separated by the presence of a stellate signum in *Sericosema*, which is absent in *Syrrhodia*.

The genus *Sericosema* is found in western North America, ranging from the northern boundary of Mexico to British Columbia and perhaps Alaska, and from the Rocky Mountain states to the Pacific Ocean.

KEY TO ADULTS

1. Under surface of hind wings bisected by dark brown line with prominent outwardly projecting tooth in middle, basad of this light gray, distad dark brown, shading into gray near outer margin.....*simularia*
— Under surface of hind wings without above characters.....2
2. Upper surface of forewings with transverse posterior line complete, prominent, subterminal area broadly suffused with dark scales; under surface of hind wings usually broadly suffused with pink, transverse line complete, prominent; expanse, 29 to 41 mm.....*juturnaria*
— Upper surface of forewings with transverse posterior line complete to obsolescent, subterminal area not suffused or only lightly so; under surface of hind wings light gray, tan, or gray brown, transverse line complete or incomplete; expanse, 25 to 37 mm.....3
3. Under surface of hind wings light gray with scattered dark brown scales, transverse line complete to obsolescent; upper surface of forewings with transverse posterior line faint to obsolescent.....*immaculata*
— Under surface of hind wings tan, gray brown, or dark gray, transverse line complete or with central third obsolescent; upper surface of forewings with transverse posterior line prominent.....4
4. Under surface of hind wings light tan to cream colored, transverse line indistinct to obsolescent; when present, usually not broken near middle; Arizona.....*wilsonensis meadowsaria*
— Under surface of hind wings light gray, dark gray to gray brown, sometimes shaded with pink or tan scales; transverse line prominent but with central one-third usually obsolescent.....5
5. Under surface of hind wings light gray brown, with numerous small, dark

- brown strigations; transverse line rarely shaded with dark scales distally; southern California.....*wilsonensis wilsonensis*
- Under side of hind wings light gray, gray brown, or red brown, heavily marked with dark brown strigations; transverse line often shaded with dark scales distally; central California to British Columbia.....*wilsonensis macdunnoughi*

KEY TO MALE GENITALIA

1. Aedeagus with vesica armed with elongate longitudinal and short transverse and terminal spines.....2
- Aedeagus with vesica armed with elongate longitudinal spines only.....*simularia*
- 2(1). Costal region of both valves with two sclerotized arms.....3
- Costal region of left valve with three sclerotized arms, the right valve with two arms.....*wilsonensis*
- 3(2). Basal costal arm as wide as or wider than width of aedeagus, with small, tooth-like projections at distal end.....*juturnaria*
- Basal costal arm narrower than aedeagus, without terminal tooth-like projections.....*immaculata*

KEY TO FEMALE GENITALIA

1. Apophyses of ovipositor shorter than or subequal to length of dorsum of segment VII.....2
- Apophyses of ovipositor longer than length of dorsum of segment VII.....3
- 2(1). Ductus bursae increasing in width anteriorly, smoothly sclerotized for entire length.....*juturnaria*
- Ductus bursae of equal width for entire length, largely sclerotized but membranous and convoluted near posterior end.....*simularia*
- 3(1). Ductus bursae membranous; bursa copulatrix attenuate.....*wilsonensis*
- Ductus bursae partially sclerotized; bursa copulatrix ovoid.....*immaculata*

Sericosema juturnaria (Guenée)

Figures 5A, 7A

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Enemera (sic!) juturnaria, DYAR, 1902, Bull. U. S. Natl. Mus., vol. 52, p. 318; 1903, Proc. U. S. Natl. Mus., vol. 25, p. 392 (description of egg); 1904, *ibid.*, vol. 27, p. 908. HOLLAND, 1903, Moth book, p. 342, pl. 43, fig. 55.

Sericosema juturnaria, BARNES AND McDUNNOUGH, 1917, Check list, p. 115. CASSINO AND SWETT, 1922, *Lepidopterist*, vol. 3, p. 151. McDUNNOUGH, 1927, *Canadian Ent.*, vol. 59, p. 246; 1938, Check list, p. 157.

Selidosema californiaria PACKARD, 1871, *Proc. Boston Soc. Nat. Hist.*, vol. 13, p. 394; 1876, *A monograph of the geometrid moths . . . of the United States*, p. 241. (New synonymy.)

Selidosema juturnaria californiaria, BUTLER, 1881, *Papilio*, vol. 1, p. 222 (misspelling).

Selidosema inturnaria californiaria, GUMPPENBERG, 1892, *Nova Acta Deutschen Akad. Naturf.*, Halle, vol. 58, p. 359.

Enemera (sic!) juturnaria californiaria, DYAR, 1902, *Bull. U. S. Natl. Mus.*, vol. 52, p. 318.

Sericosema juturnaria californiaria, BARNES AND McDUNNOUGH, 1917, Check list, p. 115.

MALE: Head, vertex and front pale gray to gray brown, with scattered light brown scales; palpi reddish brown laterally, shading into light gray terminally, dorsal surface pale gray. Thorax above light reddish brown to cream color, with admixed gray scales, ventrally and legs lighter cream brown with dark brown scales. Abdomen cream brown, with scattered dark brown scales.

UPPER SURFACE OF WINGS: Forewings, ground color pale gray brown with darker brown, reddish brown, and pink scales, usually rather heavily strigate and suffused with these latter along costal margin and distad of t. p. line; costa with numerous small, dark brown patches of scales, continuing towards radial vein as fine, lighter brown strigations, often becoming fewer in number and more indistinct posterior to this; basal area of wing to t. p. line unicolorous, unmarked except as above noted; t. p. line dark smoky brown, prominent, broad, diffuse, rarely obsolescent, arising on costa three-fifths to two-thirds distance from base at right angle, swinging outward in broad curve below radial veins to vein M_3 , recurving and running subparallel with outer margin, gradually decreasing in width, with slight outward bulge just above vein 2A, meeting inner margin with strong basal bend about three-fourths distance from base; broad, diffuse, dark smoky brown subterminal shading present in varying degrees, usually present below apex, nearly always present opposite outward curve in t. p. line, often completely filling area between line and fringes; fringes concolorous or with pinkish tinge, unmarked or with faint venular spots of dark brown. Hind wings concolorous with forewings; t. p. line usually absent, rarely indicated by few brown scales, or showing through from under surface; subterminal area usually

with broad, diffuse, dark smoky brown shading, most prominent near outer angle, fading out posteriorly; fringes as on primaries.

UNDER SURFACE OF WINGS: Ground color pale gray brown, heavily overlain with darker brown, reddish brown, and pink scales except along inner margin of forewings, darker than above. Primaries, maculation similar to above, with dark discal spot, central area sometimes broadly suffused with smoky brown, subterminal area not so heavily marked. Secondaries, often heavily suffused with pinkish, appearing darker than forewings; discal dot dark, round; t. p. line usually prominent, complete, rarely partially obsolescent, dark brown, rather sharply delimited on inner side, broadly shaded on outer side, gradually shading into ground color, arising on costal margin three-fourths distance from base, gently curving to inner margin one-half to two-thirds distance from base, often most prominent at costa; subterminal area concolorous with basal area; fringes of both wings as above, without spots. Expanse: 29 to 41 mm.

FEMALE: Like the male. Subterminal area of forewings above tending to be more suffused with dark smoky brown in some examples, while in others it is very lightly marked. Under surface of wings, especially secondaries, tending to be more suffused with pinkish. Expanse: 30 to 41 mm.

MALE GENITALIA: Uncus tapering, slightly bent towards left side medially; socius with from 16 to 30 hairs; valves, costal region symmetrical, with broad truncate arm near base, almost as long as length of tegumen, as wide as or wider than aedeagus, truncate end with several tooth-like projections, the most prominent tooth always being at outer distal margin, the two arms being asymmetrical in this respect; costal region with second smaller sclerotized arm two-thirds distance from base projecting from valve less than width of aedeagus; sacculus heavily haired basad of basal costal arm, naked at base; juxta subrectangular anteriorly; aedeagus, vesica with from three to eight longitudinal spines approximately two-fifths length of aedeagus, groups of short transverse and longitudinal spines usually contiguous, rarely separate, ranging in total number from 10 to 30, usually 16 to 19.

FEMALE GENITALIA: Ductus bursae sclerotized, gradually increasing in width towards bursa copulatrix, somewhat bent towards left side and dorsally; ductus seminalis from protruding ventral lip one-sixth to one-fourth distance from ostium to bursa copulatrix, lateral margins of this lip extending laterad to sides of

ductus bursae; bursa copulatrix ovoid, broadly attached to ductus bursae, usually with faint rings encircling large, slightly elliptical ventral signum, diameter of the latter being approximately one and one-half to two times diameter of ostium. Dorsum of segment VII approximately one and one-half times as long as dorsum of segment VI; apophyses of segment VIII approximately one-half length of dorsum of segment VII; apophyses of ovipositor subequal to length of dorsum of segment VII.

EARLY STAGES: Described by Dyar.

TYPES: *Juturnaria*, in United States National Museum. Described from four males, at least three of these being in the collection at Washington. The lectotype is hereby designated as the specimen with the label "Selidosema Juturnaria Guenée Sp. G. X no. 1164 Boite no. 257." *Californiaria*, Museum of Comparative Zoology, Harvard University, type no. 14619, described from a single female.

TYPE LOCALITIES: "Californie" (*juturnaria*); "Cal." (*californiaria*).

RANGE: Western United States, from California to British Columbia, south in Rocky Mountain states to Utah and Colorado. Packard (1876) records it from Alaska. Two specimens labeled "Volga, S. Dakota '94" in the Museum of Comparative Zoology collection, if correctly labeled, extend the distribution considerably to the east; however, this locality needs to be verified. (See fig. 1.) On the wing from May through September.

FOOD PLANT: *Rhamnus* (Dyar, 1894).

REMARKS: Four hundred and six specimens examined. This species is the largest in size and has the greatest range of any of the species in the genus. It is usually easy to determine by means of the ground color of the wings above which is the lightest in hue of any of the species, by the fact that the upper side of the forewings usually has the t. p. line very prominent and complete, and the subterminal area is often broadly suffused with dark scales. On the under surface of the wings there is considerable variation in color, but most examples, especially the females, are broadly suffused with pink; the cross line is rather variable in amount and intensity, but it is usually complete and prominent, gently curving across the wing. There is a fair amount of variation within the species in the characters just mentioned; *californiaria* is a pale and lightly marked female, with hardly a trace of the cross line on the hind wings beneath. A complete series of intergradations can

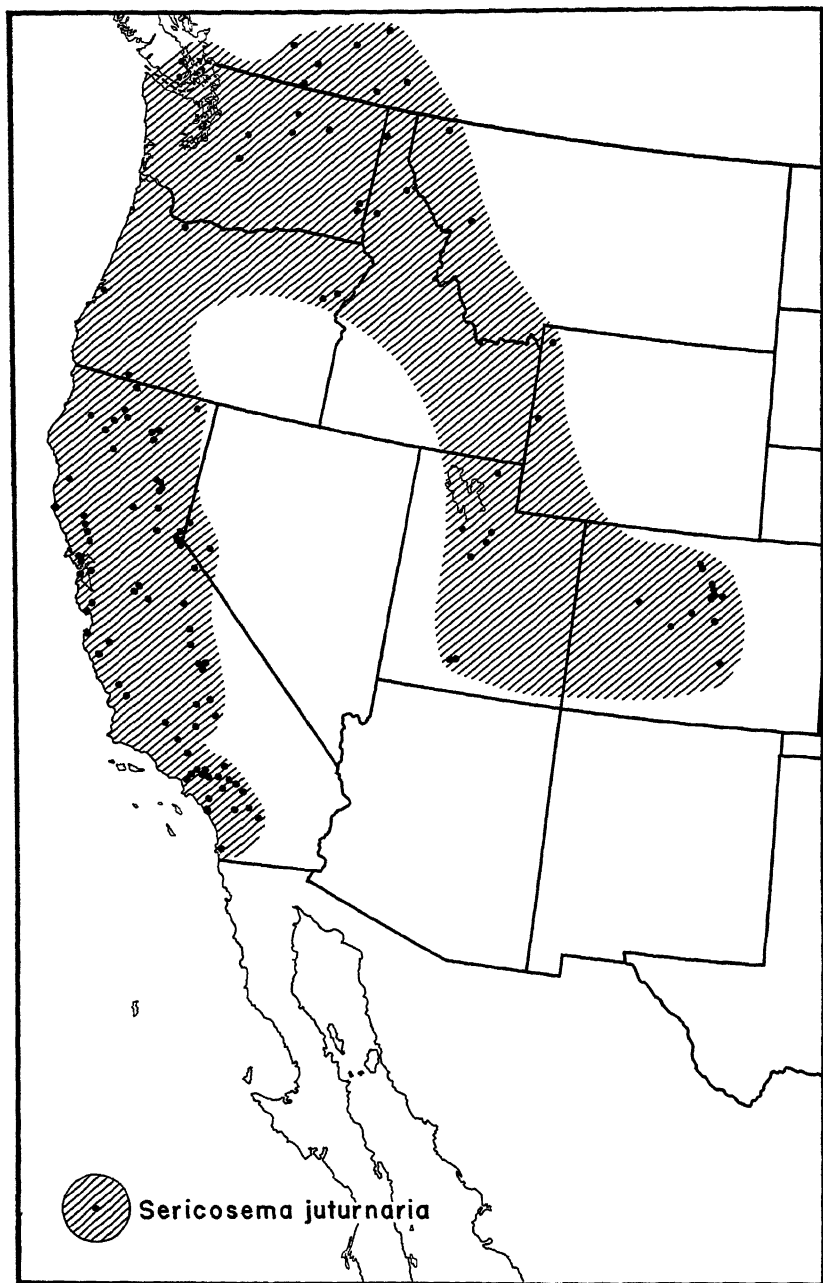


FIG 1. Distribution of *Sericosema juturnaria* (Guenée).

be found from this lightly marked form to those specimens heavily suffused with dark scales above and below which form the other extreme.

The male genitalia are very distinct, not only in being the largest in size within the genus, but in the symmetrical nature of the valves with the very broad, toothed, truncate costal arm near the base. The closest relationship appears to be with *immaculata*.

The female genitalia are also quite distinct, being recognizable by the short apophyses, the smoothly sclerotized ductus bursae increasing in width anteriorly, the ductus seminalis arising from a prominent lip, and by the relatively large signum.

Sericosema immaculata immaculata (Barnes and McDunnough)

FIGURES 5B, 7B

Euemera immaculata BARNES AND MCDUNNOUGH, 1913, Contributions to the natural history of the Lepidoptera of North America, vol. 2, p. 129, pl. 8, fig. 2.

Sericosema juturnaria immaculata, BARNES AND MCDUNNOUGH, 1917, Check list, p. 115. MCDUNNOUGH, 1938, Check list, p. 157.

MALE: Head, vertex and front whitish gray, with scattered brown scales; palpi reddish brown laterally, terminal joint light gray, especially near apex, dorsal surface concolorous with front. Thorax light gray with light brown and reddish brown cast, legs brown with gray scales. Abdomen light gray with reddish brown scales.

UPPER SURFACE OF WINGS: Forewings, ground color light tawny, with reddish brown and smoky brown scales, usually strigate and suffused with these latter along costal margin and distad of t. p. line; costa with numerous small brownish patches of scales, continuing towards radial vein as indistinct strigations, becoming obsolescent posterior to this; basal area of wing to t. p. line unicolorous, unmarked except as above noted; t. p. line smoky brown, rather narrow, gradually decreasing in width, fading out before reaching inner margin, rather faint to obsolescent, arising on costa two-thirds distance from base at right angle, swinging outward in broad curve below radial veins to vein M_3 , recurving and running parallel to outer margin, with outward bulge above vein 2A; subterminal area lightly suffused with smoky brown and reddish brown scales; fringes concolorous to gray, sometimes marked at vein endings. Hind wings concolorous or slightly paler than forewings, without markings, veins slightly

darkened; subterminal area lightly suffused with reddish brown; fringes as on primaries.

UNDER SURFACE OF WINGS: Forewings smoky brown, costal margin and apex suffused with light gray with numerous dark brown scales, inner margin lighter; costal margin with brown scales forming small strigations; t. p. line represented by rectangular block to vein M_1 , posterior to this only very faintly indicated; discal dot very faint; fringes gray, sometimes marked at vein endings. Hind wings even light gray with dark brown scales; discal dot dark brown, prominent; t. p. line complete, incomplete, or sometimes absent, dark brown, diffuse, arising on costa two-thirds distance from base, subparallel with outer margin, curving to inner margin three-fifths distance from base; fringes as on primaries. Expanse: 25 to 36 mm.

FEMALE: Like the male. Forewings above with t. p. line tending to be slightly more prominent, fringes tending to be more checkered. Expanse: 27 to 37 mm.

MALE GENITALIA: Uncus tapering, rather strongly bent towards left side medially; socius with from 10 to 18 hairs; valves, costal region with elongate, slightly asymmetrical arms arising medially in sclerotized area, being approximately three-fourths length of tegumen and approximately one-half width of aedeagus in size, arm on right side slightly longer than left arm, terminally both arms bluntly pointed or rounded; costal region with second smaller sclerotized arm three-fifths distance from base projecting only slightly from valve; sacculus heavily haired basad of basal costal arm, naked at base; juxta subrectangular to triangular anteriorly; aedeagus, vesica with from three to eight longitudinal spines of varying lengths, the shortest being about one and one-half times width of aedeagus and the longest being approximately three-quarters length of aedeagus, groups of short transverse and longitudinal spines usually well separated, the former ranging in number from 18 to 35, the latter from three to 10).

FEMALE GENITALIA: Ductus bursae sclerotized, sometimes rather weakly so anterior to point of attachment of ductus seminalis, subequal to width of ostium throughout except near junction with bursa where diameter increases slightly, somewhat bent towards left side and dorsally; ductus seminalis from sclerotized swelling one-sixth to one-eighth distance from ostium to bursa copulatrix; bursa copulatrix ovoid, attached to ductus bursae rather broadly on right posterior side with slight ridge de-

marking same, usually with faint rings encircling slightly elliptical ventral signum, diameter of the latter being subequal to diameter of ostium. Dorsum of segment VII twice as long as dorsum of segment VI; apophyses of segment VIII slightly shorter than dorsum of segment VII; apophyses of ovipositor slightly longer than, to one and one-half times length of, dorsum of segment VII.

EARLY STAGES: Unknown.

TYPE: In United States National Museum; described from a single male; illustrated with original description.

TYPE LOCALITY: Loma Linda, San Bernardino County, California.

RANGE: California, normally occurring in mountainous regions, often at higher elevations. (See fig. 2.) On the wing from May through August.

FOOD PLANT: Unknown.

REMARKS: Two hundred and twenty-one specimens examined. This is the most lightly marked species of the genus, on both the superior and inferior surfaces of the wings. That, plus the even light gray of the under side of the secondaries, usually distinguish it. However, within this species there is considerable variation in the amount of maculation, ranging from complete absence of the cross lines above and below to fairly prominent cross lines. The type from southern California is the more immaculate form; specimens from the Sierra Nevada Mountains match this quite well. More commonly the wings show a narrow cross line on the primaries above and on the secondaries below; the extreme of this is found in a series from Modoc County, California, where the maculation is quite distinct and the band on the secondaries below is about 1 mm. in width. In a single specimen from Mohawk, Plumas County, California, both the upper and lower surfaces of the wings are evenly suffused with gray black scales; this is the only known example of a melanistic tendency in the genus.

The male genitalia appear to be most like those of *juturnaria*, but are easily distinguished therefrom by the much more slender and slightly asymmetrical costal arms of the valves, in the aedeagus by the greater length of the elongate spines in the vesica, and by the larger number of the short transverse and longitudinal spines, the groups of which are farther apart. The genitalia of the type have the costal arms long, narrow, and pointed, more so than in most examples. This, however, is not a constant feature in southern California specimens; in fact, it appears in but

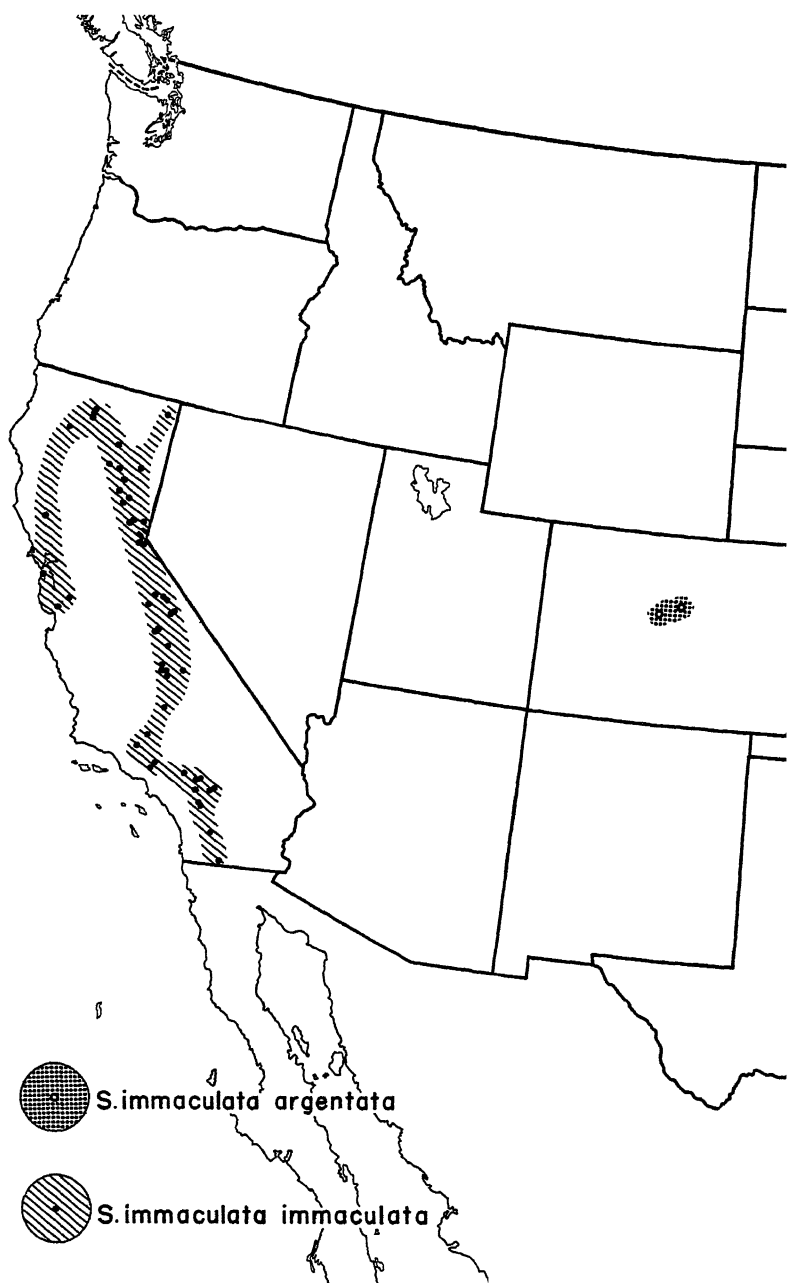


FIG. 2. Distribution of *Sericosema immaculata* Cassino and Swett.

very few of them. Yet, as one goes north, the costal arms tend to become slightly thicker and more truncate, with the entire genitalia becoming slightly larger.

The female genitalia can be recognized by the elongate nature of the apophyses and by the sclerotized nature of the ductus bursae.

***Sericosema immaculata argentata* Cassino and Swett, new status**

Sericosema argentata CASSINO AND SWETT, 1922, *Lepidopterist*, vol. 3, pp. 153, 190. McDUNNOUGH, 1938, Check list, p. 157.

This name is being retained for specimens occurring in Colorado. At present, only two examples, both males, are known to the author. Obviously this subspecies, if it is one, cannot be adequately characterized from two specimens. However, it can be stated that these examples are quite similar to those occurring in the Sierra Nevada Mountains of California. The type is relatively heavily marked, while the second specimen (labeled "Como, Park Co., Col. July. Oslar") is lightly marked. The original description matches the type quite well, except for the color used; above it is much paler than "reddish brown," while the under side of the secondaries might be more accurately described as a light gray rather than a "silvery white."

A slide was made of the genitalia of the type by Cassino. As far as can be told from the crushed condition of this slide, the genitalia seem to agree very well with those of California examples.

TYPE: Museum of Comparative Zoölogy, Harvard University, type no. 16834; described from a single male.

TYPE LOCALITY: Platte Canyon, Colorado.

RANGE: Colorado. (See fig. 2.)

***Sericosema wilsonensis wilsonensis* Cassino and Swett**

Sericosema wilsonensis CASSINO AND SWETT, 1922, *Lepidopterist*, vol. 3, p. 151. McDUNNOUGH, 1938, Check list, p. 157.

MALE: Head, vertex and front cream to gray brown; palpi cream brown laterally, with scattered brown scales, occasionally light gray dorsally. Thorax gray brown above, ventrally and legs lighter gray, with dark brown scales. Abdomen gray, with scattered dark brown scales.

UPPER SURFACE OF WINGS: Forewings, ground color cream gray to light tawny, with dark brown, smoky brown, and yellow brown scales, usually strigate and suffused with these latter along costal

margin and distad of t. p. line; costa with numerous small dark brown patches of scales, continuing towards radial vein as fine dark brown strigations, becoming indistinct or absent posterior to this; basal area of wing to t. p. line unicolorous ground color, sometimes with scattered darker scales; t. p. line dark smoky brown, prominent, sometimes diffuse distally, arising on costa two-thirds distance from base at right angle, swinging outward in broad curve below radial veins, becoming progressively narrower posteriorly, recurving to vein Cu_2 , going straight or with slight outward bulge above vein 2A to inner margin with slight basal bend at four-fifths distance from base; subterminal area somewhat darker than inner portion of wing, broadly suffused with dark brown or smoky brown scales, occasionally these heaviest near apex and more often opposite or just below outward bulge in t. p. line; fringes concolorous or light gray in terminal half, sometimes checkered. Hind wings concolorous with forewings; t. p. line absent, rarely showing through from under surface; subterminal area more or less suffused with dark brown or smoky brown scales, most prominent near outer angle of t. p. line, fading out posteriorly; fringes as on primaries.

UNDER SURFACE OF WINGS: Forewings cream brown to smoky brown, darker than above; costal margin and apex light gray to yellow brown, with numerous dark brown strigations; discal dot faint; t. p. line usually present on costa and extending to end of cell, absent or obsolescent posterior to this; fringes gray or concolorous with wing, checkered or plain. Hind wings light gray brown with numerous dark brown or reddish brown scales; discal dot dark brown, small, rather diffuse; t. p. line dark smoky brown, narrow, somewhat diffuse, arising on costa two-thirds to three-fourths distance from base, extending to vein M_1 , absent in center of wing, then reappearing as diffuse patch between veins Cu_1 and 2A; subterminal area concolorous with basal area, rarely with darker area distad of t. p. line near costa; fringes as on forewings. Expanse: 26 to 32 mm.

FEMALE: Like the male, but forewings above often tending to be slightly suffused with smoky brown scales, especially in subterminal area; fringe usually with ends of veins darkened. Under surface of both wings often somewhat more contrastingly marked, with ground color being lighter than in male, rarely shaded with pink or red brown, t. p. line more heavily represented, sometimes shaded distally with dark brown scales, on secondaries the line as

thick as 1 to 2 mm. near costa; hind wings rarely with sub-terminal area darker than basal portion of wing. Expanse: 26 to 32 mm.

MALE GENITALIA: Uncus not tapering or only very slightly so, slightly bent towards left side medially; socius with from 16 to 24 hairs; valves, costal region asymmetrical, right valve with two arms, left valve with three arms; right valve with elongate arm arising medially in sclerotized area, being approximately three-fourths length of tegumen and one-half to two-thirds width of aedeagus in size, terminally rounded or bluntly pointed, second smaller sclerotized arm three-fifths distance from base projecting a distance subequal to width of basal costal arm; left valve with elongate arm arising medially in sclerotized area, approximately same size as arm on right side but tending to be more pointed and narrower, second smaller sclerotized arm located between basal and terminal arms, smaller than, and one-half the length of, basal arm, terminally truncate or pointed, third sclerotized arm three-fourths distance from base similar to corresponding arm on right valve, shorter than second arm on left valve but similar in outline; valvula with from eight to 12 hairs arising from small tubercles basad of basal costal arm, sacculus lightly haired basad of this, naked at base; juxta subrectangular to triangular anteriorly; aedeagus, apex with short heavy spine, vesica with from five to 10 longitudinal spines of varying length, the shortest being about one and one-half times width of aedeagus and the longest being one-half length of aedeagus, groups of short transverse and longitudinal spines usually separate, sometimes contiguous, the former ranging in number from 24 to 34, the latter from seven to 14.

FEMALE GENITALIA: Ductus bursae membranous, sclerotized between ostium and point of attachment of ductus seminalis, subequal in width to ostium; ductus seminalis from sclerotized swelling one-sixth to one-eighth distance from ostium to bursa copulatrix; bursa copulatrix elongate, broadly attached to ductus bursae with crenulate ridge demarking same, with or without faint rings encircling more or less circular dorsal signum, diameter of the latter being subequal to or slightly larger than diameter of ostium. Dorsum of segment VII one and one-half times to twice as long as dorsum of segment VI; apophyses of segment VIII two-thirds to four-fifths length of dorsum of segment VII; apophyses of ovipositor one and one-quarter times length of dorsum of segment VII.

The male genitalia can be easily separated from those of *juturnaria* and *immaculata* by the asymmetrical number and position of costal arms of the valves, and by the short heavy spine on the apex of the aedeagus. In these respects the genitalia are similar to those of *simularia*, but can be distinguished therefrom by the more elongate costal arms and by the presence of short transverse and longitudinal spines in the vesica of the aedeagus. The female genitalia can be recognized by the elongate nature of the ovipositor apophyses, together with the membranous ductus bursae and elongate bursa copulatrix.

Within the species there is not much difference in genitalia in either males or females. There is some variability in the length, width, and shape of the basal costal arms, but this is, to a large extent, an individual character; the genitalia of the holotype and a paratopotype show considerable variability here, for example. There is a similar amount of variation in the spining of the vesica, especially in the size and number of the short transverse and longitudinal groups. The female genitalia do not show much variability.

EARLY STAGES: Unknown.

TYPE: Museum of Comparative Zoölogy, Harvard University, type no. 16835.

TYPE LOCALITY: Mount Wilson, Los Angeles County, California.

RANGE: Southern California. (See fig. 3.) On the wing during June, July, and August.

FOOD PLANT: Unknown.

REMARKS: Thirty-four specimens examined. Examples of this species are most likely to be confused with small specimens of *juturnaria*. Specimens of the latter usually average about 5 mm. greater in wing expanse than in this species; *juturnaria* also tends to have the superior surfaces of the wings with a slightly lighter ground color. Both species have the upper surface of the forewings marked with a prominent and complete t. p. line and with the subterminal area more or less suffused with dark scales. However, the t. p. line in *wilsonensis* is usually more strongly bent outward, and it meets the inner margin of the wing somewhat farther out than in *juturnaria*. On the average the subterminal area of *wilsonensis* is somewhat less heavily suffused than in *juturnaria*, although this character is variable in both species. The former species tends to have the suffusion most prominent opposite the

outward bulge of the t. p. line, whereas in *juturnaria* it is usually more widespread. The under side of the secondaries offers the

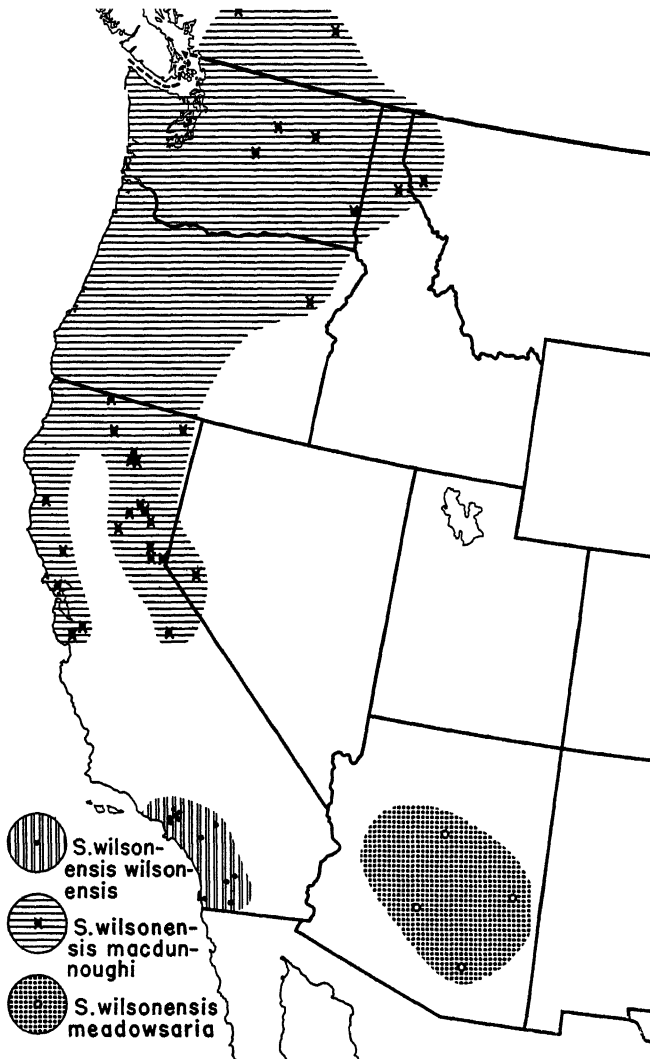


FIG. 3. Distribution of *Sericosema wilsonensis* Cassino and Swett.

best diagnostic characters. In *wilsonensis* the color tends to a dark brown or gray brown, more or less heavily dotted with

darker scales, with the cross line often contrastingly marked and lacking or reduced in the middle third of the wing. In *juturnaria* the color tends to be a more uniform pink, with a smoother appearance, and the cross line is nearly always complete and less contrastingly marked. In some specimens of *wilsonensis* the discal dots of the under side of the wings are quite prominent, more so than in *juturnaria*; however, this character is a rather variable one.

Sericosema wilsonensis can be divided into three subspecies. Typical *wilsonensis*, from southern California, is somewhat intermediate in color and maculation between the Arizona subspecies *meadowsaria* and the subspecies that ranges from central California northward. The best diagnostic characters to separate these three are found on the under side of the secondaries. Nominate *wilsonensis* can usually be distinguished by the fact that the color here is a light gray brown, sometimes shaded with a red brown tone, with numerous, rather small, dark brown strigations; that the t. p. line usually is rather sharply contrasted in color against the ground color of the wing; that it is absent in the center of the wing; and that it is only rarely shaded with dark scales distally.

***Sericosema wilsonensis meadowsaria* Sperry, new status**

Sericosema meadowsaria SPERRY, 1948, Bull. Brooklyn Ent. Soc., vol. 43, p. 89.

MALE: Forewings above tending to be slightly more tawny in color than in the nominate subspecies, only lightly suffused with darker scales; t. p. line tending to be less prominent. Under surface of wings light tan; forewings with t. p. line tending to be indistinct or obsolescent; hind wings with t. p. line indistinct, obsolescent, or absent, subterminal area concolorous with basal area, very rarely darkened distad of t. p. line. Expanse: 28 to 32 mm.

FEMALE: Like the male, but forewings above tending to be more cream colored, only very sparsely suffused with smoky brown scales; subterminal area almost concolorous with basal area; occasionally with pinkish cast to costal margin and fringe. Under surface of both wings also cream colored, very lightly marked with darker scales, slightly shaded with pink or red brown; cross line lightly indicated, not nearly so contrastingly marked as in the nominate subspecies, very rarely thickened with distal shading; hind wings with subterminal area almost never darker than basal portion. Expanse: 28 to 34 mm.

MALE GENITALIA: Valves, costal region of both valves with basal arms somewhat shorter and thicker than in the nominate subspecies, basal arm on right side tending to be truncate apically, occasionally with a tooth at each outer margin, basal arm of left side subequal to one-half the width of corresponding arm on right side; aedeagus, vesica with elongate longitudinal spines sometimes one-half length of aedeagus, groups of short transverse and longitudinal spines often contiguous, sometimes separate.

FEMALE GENITALIA: As in the nominate subspecies.

EARLY STAGES: Unknown.

TYPE: In collection of John L. Sperry, Riverside, California.

TYPE LOCALITY: Todd's Lodge, Oak Creek Canyon, Arizona.

RANGE: Arizona. (See fig. 3.) On the wing during June, July, and August.

FOOD PLANT: Unknown.

REMARKS: Twenty-five specimens examined. This subspecies is the palest in color and the most lightly marked, both above and below, of any of the races. The under side of the secondaries varies from light cream to tan, sometimes lightly shaded with pink or red brown, and less heavily marked with dark strigations; the t. p. line is indistinct, obsolescent, or absent; when present, it is not nearly so contrastingly marked as in the nominate subspecies.

***Sericosema wilsonensis macdunnoughi*, new subspecies**

Figures 6A, 7C

Sericosema wilsonensis McDUNNOUGH (not Cassino and Swett), 1927, Canadian Ent., vol. 59, p. 266.

MALE: Upper surface of forewings suffused with very pale pinkish brown scales and numerous fine smoky brown strigations, especially along costal margin and in area distad of t. p. line; costa narrowly light gray in outer half of wing; subterminal area contrasting with basal area owing to heavier concentration of dark brown strigations, with apex and area opposite to and just below outward bulge in t. p. line darkest; fringes light gray in terminal half, contrasting owing to light color, checkered; hind wings concolorous with primaries, rather heavily suffused with dark scales in outer portion of wing. Under surface of wings light gray, heavily overlain with dark brown and smoky brown strigations; forewings with costa and apex showing lighter than remainder of

wing; fringes as above. Hind wings beneath very heavily and evenly strigate with dark scales; discal dot and t. p. line not appearing prominently but as thickening of strigations, t. p. line absent in center of wing; subterminal area almost concolorous with basal area, being very slightly darker distad of t. p. line; fringes lighter than wing. Expanse of holotype: 33 mm.

FEMALE: Like the male, but forewings above more cream colored and less heavily marked with dark scales, especially in area basad of t. p. line; t. p. line slightly more prominent and with slightly less outcurve than in male; subterminal area contrasting with basal area owing to even suffusion of orange brown and dark brown scales, the latter concentrated only opposite outward bend in t. p. line; secondaries with maculation of under side showing through faintly. Under surface of wings light gray, only lightly strigate with dark brown scales; forewings only darkened distad of t. p. line, especially in posterior half or two-thirds of wing; secondaries with discal dot and t. p. line showing strongly, the latter obsolescent in middle of wing; subterminal area and fringes concolorous with basal area. Expanse of allotype: 30 mm.

MALE GENITALIA: Valves, costal region of both valves with basal arms tending to be slightly longer and thinner than in the nominate subspecies, basal arm on right side either truncate or bluntly pointed apically, basal arm on left side slightly narrower than width of corresponding arm on right side; aedeagus, groups of short transverse and longitudinal spines in vesica sometimes tending to be reduced in size and number.

FEMALE GENITALIA: As in the nominate subspecies.

TYPES: Holotype, male, Seton Lake, Lillooet, British Columbia, July 8-10, 1926 (J. McDunnough); allotype, female, Seton Lake, British Columbia, July 21, 1933 (J. McDunnough); both in Canadian National Collection, Ottawa. Paratypes, seven males and two females: Seton Lake, British Columbia, July 8-10, 1926, and July 22, 1933 (J. McDunnough); Wallace, Idaho, July 30, 1934, and August 27, 1933; Trout Valley, Montana, August 5, 1941 (G. H. and J. L. Sperry); Pateros, Washington, May 26, 1933; Black Canyon, Washington, June 18, 1933. Paratypes to be distributed as follows: California Academy of Sciences, United States National Museum, Canadian National Collection, the American Museum of Natural History, and collection of John L. Sperry of Riverside, California.

RANGE: British Columbia, Washington, Idaho, and Montana south to central California and adjacent regions of Nevada. (See fig. 3.) On the wing from May through September.

FOOD PLANT: Unknown.

REMARKS: Eighty-three specimens examined. As in the other subspecies, there is a fair amount of variability in the color and maculation, especially on the under side of the hind wings. The superior surfaces of the wings tend to be more shaded with pinkish brown scales and with more numerous fine smoky brown strigations, especially in the males; this gives the wings a somewhat darker appearance than in the other subspecies. The upper surface of the wings in the female, on the other hand, tends to be less heavily marked with dark scales than in the male, and there is usually more of a contrast in color between the basal and distal parts of the wings. The under surface of the secondaries varies from a light gray to gray brown and red brown, all heavily overlain with numerous dark strigations in the male, less heavily so in the female. The t. p. line is rather variable, ranging from being obsolescent to completely present. In the males, it is complete in about one-half the specimens examined, obsolescent between veins M_1 and Cu_1 in one-quarter, and altogether absent in this area in the remaining one-quarter; in the females, the t. p. line is absent in the center of the wing in a little over three-sevenths of the specimens, obsolescent medially in a little less than three-sevenths, and complete in only one-seventh of the specimens examined. The subterminal area is rather variable also, ranging from being concolorous with the basal portion of the wing, to having a slight dark shading distad of the t. p. line, to having part or all of the subterminal area suffused with reddish brown or dark smoky brown scales. Expanse: males, 26 to 33 mm.; females, 28 to 35 mm.

This subspecies can be distinguished from the other races by the slightly darker color of the wings above, by the darker under side of the secondaries and usually with more and heavier dark strigations, by the tendency of the t. p. line to be complete, and the fact that the subterminal area is often darker than the basal area of the wing.

This subspecies is named in honor of my friend and colleague, Dr. J. H. McDunnough, who captured the types and recorded them in the literature. This name is purposely misspelled as an aid in pronunciation.

Sericosema similaria (Taylor)

Figure 6B, 7D

Enemera (sic!) similaria TAYLOR, 1906, Ent. News, vol. 16, p. 190. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 275.

Sericosema similaria, BARNES AND McDUNNOUGH, 1917, Check list, p. 115. CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 152. McDUNNOUGH, 1938, Check list, p. 157.

MALE: Head, vertex and front light gray to gray brown palpi light reddish brown laterally, dorsal surface concolorous with front. Thorax light gray to gray brown above, ventrally and legs light gray with scattered brown scales. Abdomen light gray with brown scales.

UPPER SURFACE OF WINGS: Forewings, ground color light tan, with orange brown, reddish brown, dark brown, or smoky brown scales, usually strigate and suffused with these latter along costal margin and distad of t. p. line; costal region with pinkish to yellow brown cast, with numerous small brownish patches of scales continuing towards radial vein as fine strigations, becoming obsolescent posterior to this, often with fairly prominent mark at one-third distance from base; basal area of wing to t. p. line unicolorous, unmarked except as above noted; t. p. line smoky brown, prominent to obsolescent, rather narrow except at origin on costa one-half to three-fifths distance from base, going at outward oblique angle to vein M_2 , turning sharply posteriorly, often fading out before reaching inner margin, going almost in straight line with slight outward bulge above vein 2A and with slight basal bend to inner margin at three-fourths distance from base; subterminal area often heavily suffused with smoky brown below apex and between veins M_3 and Cu, fading out posteriorly; fringes concolorous, lighter gray in terminal half, sometimes marked at end of veins. Hind wings concolorous with forewings; t. p. line usually absent, rarely indicated by few brown scales, or showing through from under surface; subterminal area often suffused with smoky brown scales, most prominent near outer angle, fading out posteriorly; fringes as on primaries.

UNDER SURFACE OF WINGS: Forewings brown to smoky brown, darker than above; costal margin and apex light gray to reddish brown, with numerous dark brown strigations; discal dot faint; t. p. line from prominent brown patch on costa, otherwise indistinct or obsolescent, course as above; subterminal area suffused with smoky brown as above; fringes as above. Hind wings light

gray, with numerous dark brown scales in basal region; discal dot faint; t. p. line prominent, dark smoky brown, broadly diffuse outwardly, arising on costa about one-half distance from base at right angle, going to inner margin three-fifths distance from base, sharply bent outwardly between veins R and Cu_1 with smaller outward bend at vein 2A; terminal half of wing broadly shaded with smoky gray from t. p. line, gradually becoming light gray near outer margin; fringes as on primaries. Expanse: 25 to 32 mm.

FEMALE: Like the male; forewings above tending to be less suffused with dark scales; t. p. line usually present, distinct, although sometimes obsolescent; fringes tending to be marked at ends of veins. Under surface of forewings tending to be more shaded with reddish brown; t. p. line present, fading out just before reaching inner margin; fringes as above. Expanse: 28 to 35 mm.

MALE GENITALIA: Uncus tapering, apex swollen, especially on right side, rather strongly bent towards left side medially; socius with from 12 to 20 hairs; valves, costal region asymmetrical, right valve with costal arms separated by width of aedeagus, left valve with medial swelling and with costal arms approximated terminally; right valve with prominent arm arising two-thirds length of costa from base, being approximately one-half length of tegumen and wider than width of aedeagus in size, terminally rounded, second smaller sclerotized arm two-thirds distance from base projecting from valve less than width of aedeagus; left valve with broad triangular medial swelling, first costal arm located between median swelling and terminal arm, three-quarters distance of valve from base, height less than width of aedeagus, broadly rounded apically; second costal arm five-sixths distance from base similar to corresponding arm on right valve, subequal in size to first costal arm; valvula and sacculus lightly haired medially; juxta subtriangular anteriorly, sometimes scarcely differentiated; aedeagus, apex with short spine, vesica armed with from four to seven longitudinal spines ranging from one-third to one-half length of aedeagus, short transverse and longitudinal spines absent.

FEMALE GENITALIA: Ductus bursae sclerotized, membranous for approximately twice diameter of ostium anterior to point of attachment of ductus seminalis, membranous area and adjacent anteriorly sclerotized area convoluted, anterior half of ductus smoothly sclerotized and of equal width; ductus seminalis from

sclerotized swelling one-eighth distance from ostium to bursa copulatrix; bursa copulatrix ovoid, broadly attached to ductus



FIG. 4. Distribution of *Sericosema simularia* (Taylor).

bursae, with or without faint rings encircling more or less circular dorsolateral signum, diameter of the latter slightly larger than

diameter of ostium. Dorsum of segment VII one and one-third times as long as dorsum of segment VI; apophyses of segment VIII one-half length of dorsum of segment VII; apophyses of ovipositor subequal in length to dorsum of segment VII.

EARLY STAGES: Unknown.

TYPE: In United States National Museum. Described from two worn specimens; the lectotype, hereby designated, is the specimen labeled by Taylor as "Type 1." This specimen is a female, with genitalia on slide HWC 1802.

TYPE LOCALITY: Pasadena, California.

RANGE: California, extending from San Diego County up the coastal mountain ranges as far north as Shasta County. (See fig. 4.) On the wing from May through August.

FOOD PLANT: Unknown.

REMARKS: Eighty-three specimens examined. This species is the one least likely to be misidentified. The under side of the secondaries is very distinct, having the light gray basal half sharply delimited from the gray brown terminal portion by the outwardly toothed dark brown cross line. On the upper surface of the wings, the ground color is slightly darker than in the other species, and the more strongly angled t. p. line of the forewings is also characteristic.

The male genitalia are similar to those of *wilsonensis* in that the costal region of the valves is asymmetrical, but in this species the arms are much shorter and broader. The aedeagus is unique in completely lacking any short transverse and longitudinal spines in the vesica.

The female genitalia are distinguished by the short apophyses, and by the membranous and convoluted nature of the ductus bursae near the point of attachment of the ductus seminalis.

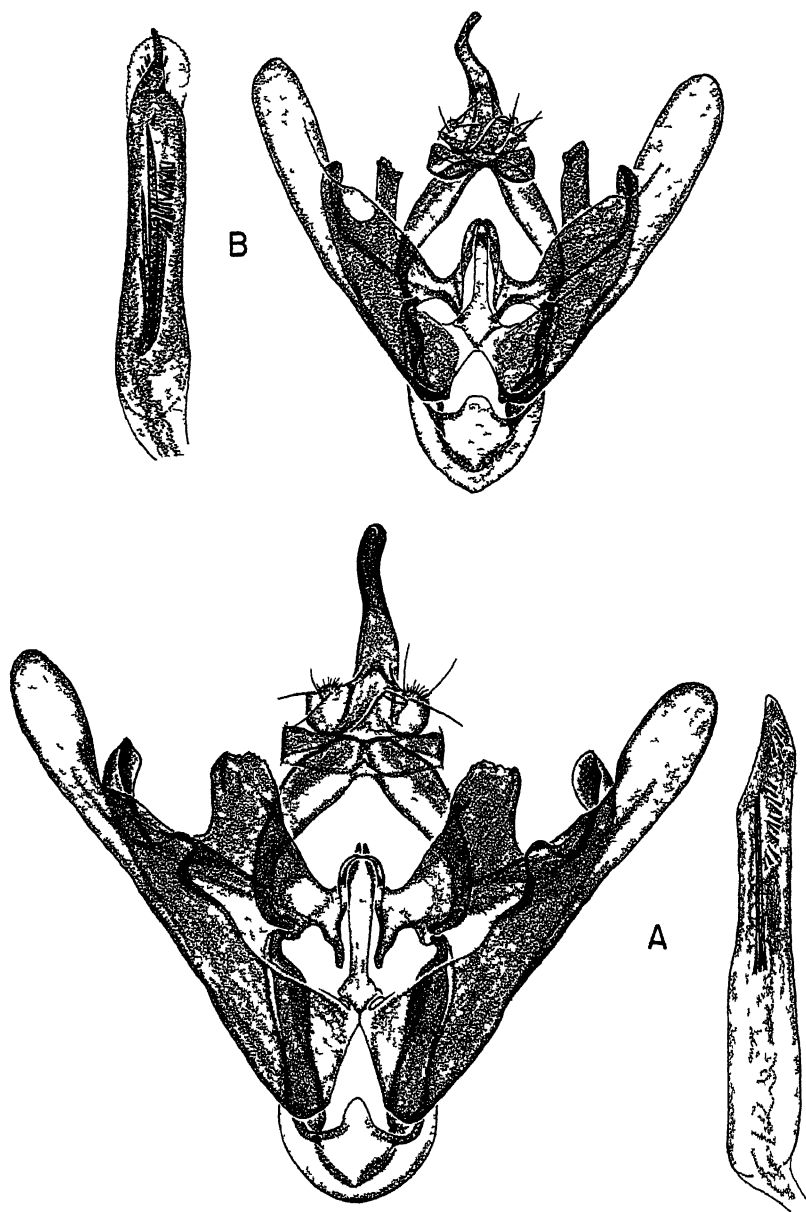


FIG 5 Male genitalia of *Sericosema* A. *S. juturnaria* (Guenée), Keddie, Plumas County, California, June 17, 1941 (F H Rindge) B. *S. immaculata* (Barnes and McDunnough), Plumas County, California, July, 1905

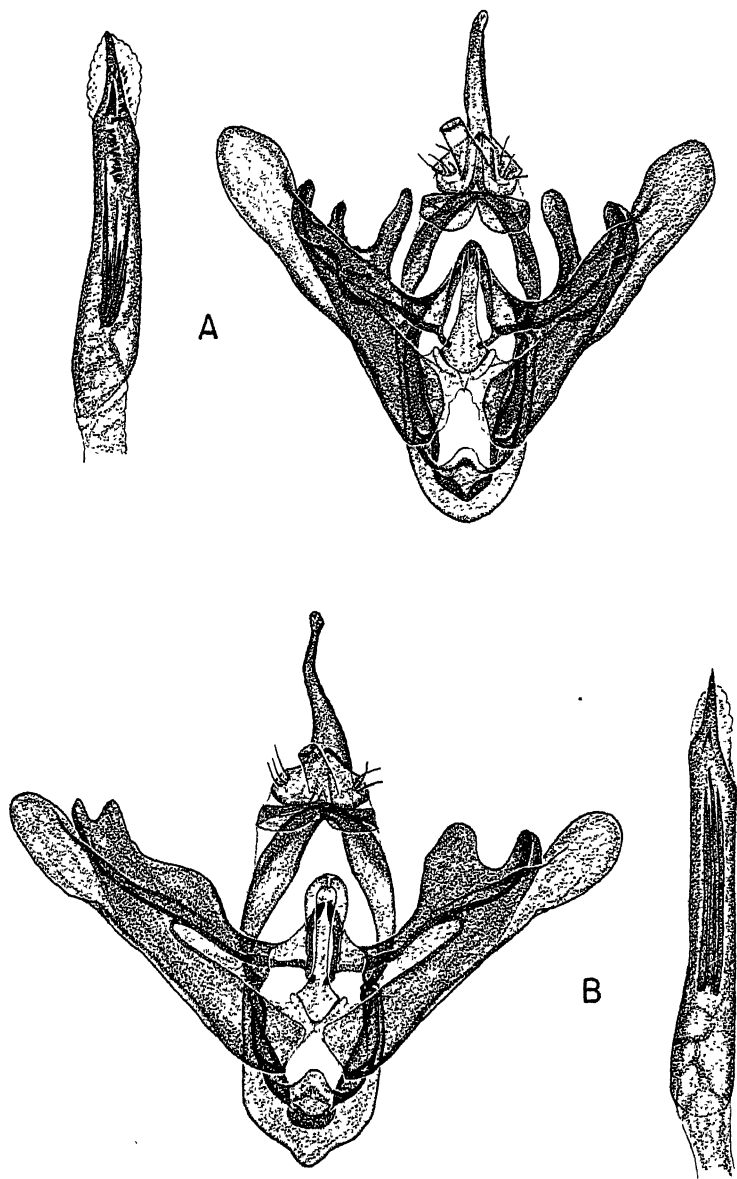


FIG. 6. Male genitalia of *Sericosema*. A. *S. wilsonensis macdunnoughi* Rindge, San Antonio Ranger Station, Santa Clara County, California, July 21, 1948 (R. van den Bosch). B. *S. simularia* (Taylor), San Diego, California, June 5, 1910 (George H. Field).

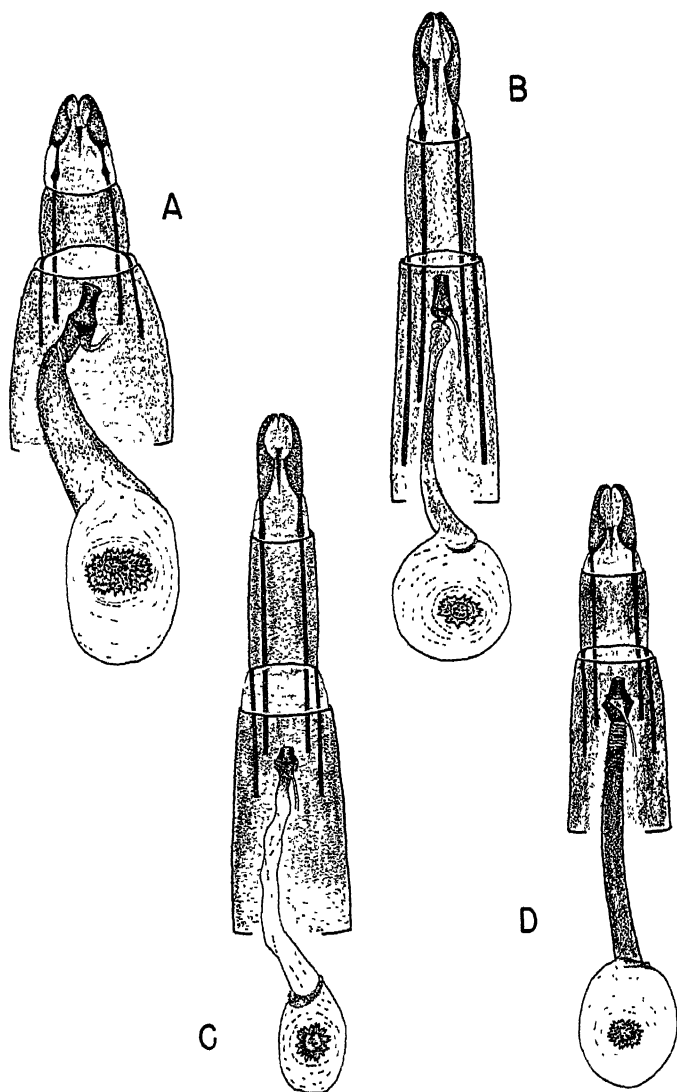


FIG. 7. Female genitalia of *Sericosema*. A. *S. juturnaria* (Guenée), Placer County, Sierra Nevadas, California, ex collection Henry Edwards. B. *S. immaculata immaculata* (Barnes and McDunnough), Sierra Nevadas, California, ex collection Henry Edwards. C. *S. wilsonensis macdunnoughi* Rindge, Keddie, Plumas County, California, July 13, 1941 (F. H. Rindge). D. *S. simularia* (Taylor), San Antonio Ranger Station, Santa Clara County, California, July 17, 1948 (R. van den Bosch).

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A REVISION OF THE NORTH AMERICAN SPECIES OF THE GENUS *SYRRHODIA* (LEPIDOPTERA, GEOMETRIDAE)

BY FREDERICK H. RINDGE¹

This small group of moths is much better known under the generic name of *Catopyrrha* Hübner. A careful study of the respective genotypes indicates that they are congeneric, so a change in the generic name becomes necessary. This was suggested by Forbes (1948) but was not used at that time.

There has been but little trouble with identifications on the specific level since Grossbeck's paper (1912), in which he clearly differentiated the two species that occur in the eastern and southern United States. Much more collecting is needed to determine accurately the limits of distribution of the species concerned, the extent of the flight periods, and intraspecific variations. Life history work is badly needed, not only to supply food plant records, but to furnish a basis for comparison of the eggs, larvae, and pupae on both specific and generic levels.

MATERIALS STUDIED: Over 350 specimens have been studied, including all the types in this country. This material has been made available to the author through the kindness of the authorities in some of the major eastern and western museums, and the cooperation of several private collectors; these are referred to specifically in the following paragraph. A large number of genitalic slides have been prepared by the author, mainly from specimens in the collection of the American Museum of Natural History and his personal collection, and additional slides have been examined at the United States National Museum and

¹ Assistant Curator, Department of Insects and Spiders.

Museum of Comparative Zoölogy, Harvard University; these have served as the basis for the genitalic descriptions and drawings.

ACKNOWLEDGMENTS: The author wishes to acknowledge with thanks the cooperation and aid of the following men who have allowed him to study the types and specimens in their charge: Mr. John G. Franclemont of the United States National Museum; Dr. J. Bequaert of the Museum of Comparative Zoölogy, Harvard University; Dr. J. B. Schmitt of Rutgers University; and Dr. Edward S. Ross of the California Academy of Sciences. A similar word of thanks goes to Mr. John L. Sperry of Riverside, California, for the privilege of studying specimens from his private collection, and to Mr. Laurence R. Rupert of Horseheads, New York, for the privilege of studying his larval material in this genus. The author is grateful for the help of Miss Alice Gray of the American Museum of Natural History who prepared the distribution maps and arranged the genitalic drawings in preparation for publication.

GENUS SYRRHODIA HÜBNER

Syrrhodia HÜBNER, 1823, *Zuträge zur Sammlung exotischer Schmettlinge*, vol. 2, p. 29; "1816" [1823], *Verzeichniss bekannter Schmetterlinge*, p. 300. DRUCE, 1892, *Biologia Centrali-Americana*, Insecta, Lepidoptera-Heterocera, vol. 2, p. 44. HEMMING, 1937, Hübner, vol. 2, p. 259. SCHAUS, 1940, *Scientific survey of Porto Rico and the Virgin Islands*, New York Acad. Sci., vol. 12, pt. 3, p. 312.

Catopyrrha HÜBNER, "1816" [1823], *Verzeichniss bekannter Schmetterlinge*, p. 300. WALKER, 1862, *List of the specimens of lepidopterous insects in the collection of the British Museum*, pt. 24, p. 1064. HULST, 1896, *Trans. Amer. Ent. Soc.*, vol. 23, p. 340. FORBES, 1948, *Cornell Univ. Agr. Exp. Sta.*, mem. 274, p. 70.

Head, front flat, with strong projecting triangular tuft; eyes large, round; antennae of male bipectinate nearly to apex, pectinations arising in central region of segments, of female simple; tongue present; labial palpi strongly developed, middle segment heavily scaled extending well beyond front, terminal segment slightly shorter than length of eye. Thorax without tufts; legs without hair pencils, fore tibiae with fairly strong process, hind tibiae not dilated, with two pairs of spurs. Abdomen without tufts. Forewings broad, costa arched near apex, outer margin curved, 12 veins, no areoles; R_1 from top of cell approximated to, or shortly anastomosing with, Sc, R_2 to R_5 stalked, from top near upper angle, R_2 from stalk before R_5 ; M_1 from upper angle; M_2 from just above middle of DC; M_3

and Cu_1 from just before lower angle of cell; Cu_2 from well before outer angle; fovea absent. Hind wings broad; frenulum strong in both sexes; outer margin slightly concave between veins; fovea in Sc large, slender; Sc approximate to R near base for one-half length of cell; R and M_1 approximate, from just before upper angle of cell; DC oblique; M_3 from lower angle, approximate with Cu_1 at base; Cu_2 from well before outer angle. Forewings and hind wings concolorous, rarely not so, brown, yellow, or green; forewings above with t. a., median, and t. p. lines present or obsolescent, s. t. line absent, discal dot weak or absent; hind wings with one or two cross lines, discal dot weak or absent. Beneath similar to upper surface, often broadly suffused with pink, red, or brown, usually more strongly marked, discal dots usually present on all wings.

MALE GENITALIA: Uncus long, simple, strongly curved dorsally, sparsely haired, apex with strong spine; socius fairly strong, with from nine to 32 hairs; gnathos rudimentary to obsolescent; valves sclerotized basally, costal region with prominent sclerotized arm, symmetrical or asymmetrical, apex pointed or swollen, small tubercle or swelling with elongate hairs near base of arm, valve distad of arm sclerotized part way to apex; arms of transtilla sclerotized, enlarged medially; cristae absent; juxta broad; furca absent; saccus projecting short distance beyond base of valves, bluntly pointed or rounded; subequal to, or slightly longer than, uncus; aedeagus elongate, in length slightly shorter to longer than combined length of tegumen and saccus, slender, bluntly rounded or tapering to point posteriorly on ventral surface, vesica unarmed or with sclerotized or scobinate patch. Ventral surface of eighth abdominal segment without plate.

FEMALE GENITALIA: Ostium simple; operculum absent; ductus bursae sclerotized, very short, subequal in length to length of ovipositor lobes; ductus seminalis from ventral surface of ductus bursae; bursa copulatrix membranous, ranging in length from one and one-half to five times length of apophyses of ovipositor, with one or two spermatophores enlarged distally, signum absent.

EARLY STAGES: Partially described by Guenée, after Abbott. The following larval description was made from material reared by Mr. Laurence R. Rupert and is based on *cruentaria* only.

EGGS: Undescribed.

LARVAE, FIFTH INSTAR: Head, first adfrontal seta (Adf_1) above

middle of clypeus, second adfrontal (Adf_2) above branching of epicranial suture; first posterior seta (P_1) below level of Adf_2 , second posterior seta (P_2) vertically above P_1 , these three setae forming an acute angle; lateral seta (L_1) well below P_1 , but these two forming an almost straight line with Adf_2 ; first anterior seta (A_1) on level with ocellus three, second anterior seta (A_2) above ocelli and forming an almost straight line with A_1 and Adf_1 , third anterior seta (A_3) below Adf_1 in horizontal plane but level with L_1 , the three anterior setae forming slightly less than a right angle; all six ocelli well developed, located on lateral surface of head with lowest ocelli partially on anteroventral surface of head capsule; second ocellar seta (O_2) on level with bottom of ocellus one, third ocellar seta (O_3) posterior to ocellus five, the three ocellar setae forming a right angle; subocellar seta (SO_2) posterior to lowest ocellus. Thorax, prothorax with shield, with setae 1a, 1b, and 2a, 2b well separated; seta 3 double, higher than spiracle; seta 4 on level with lower rim of spiracle; seta 5 approximate; setae 6 and 7 approximate. Mesothorax, seta 2a located ventrally below 1b, seta 2b the most anterior of the four; seta 3 slightly posterior to or ventrally below 1a; seta 4 lower than 3; seta 5 ventral and approximate to 4; seta 6 ventral to 2a, 2b. Metathorax similar to mesothorax except seta 1b ventral to 1a. Abdomen, segment I, seta 1 above anterior rim of spiracle; seta 2 posterior; seta 3 above and slightly anterior to spiracle; seta 4 on level with and posterior to middle of spiracle; seta 5 well anterior of 3, below spiracle; seta 6 slightly anterior to 3; seta 7 above 6, posterior to 2. Segments II to V, seta 1 anterior to spiracle; seta 2 posterior; seta 3 below 1, higher than spiracle; seta 4 on level with middle of spiracle, anterior to 2; seta 5 very slightly posterior to 3, lower than 4; seta 6 ventrally posterior to 5, anterior to spiracle; seta 7 between levels of 5 and 6, posterior to 2. Segment VI similar, except setae 3 and 5 closer in vertical plane to spiracle, the latter below spiracle; seta 6 anterior to 5. Segment VII similar to VI, except seta 1 closer in ventral plane to spiracle; seta 4 opposite center of spiracle; seta 6 below 4. Segment VIII similar to VII, except setae 1 and 3 above spiracle.

PUPA: Undescribed.

GENOTYPE: *Syrrhodia decrepitaria* Hübner (monobasic).

This genus shows relationships to both *Sericosema* Warren (Rindge, 1950, Amer. Mus. Novitates, no. 1468, pp. 1-30) and to the *Drepanulatrix* complex (Rindge, 1949, Bull. Amer. Mus.

Nat. Hist., vol. 94, pp. 231-298). *Syrrhodia* can be distinguished from all these genera by the branching of the radial vein in the forewings, as R_2 comes off the stalk before R_5 . The male genitalia appear to be a more complex development from the simpler *Drepanulatrix* type, showing, among other features, a stronger uncus, a more complicated valve with prominent costal arms, and a more intricate transtilla and juxta. The female genitalia, on the other hand, are less complicated, with the bursa copulatrix tending to be a more or less simple sac, showing only the rudiments of longitudinal rows of teeth, and with a short and rather uniform ductus bursae. The mature larvae of *Syrrhodia*, as far as is known, will key out to *Drepanulatrix* (1949, *ibid.*, p. 243). There are, however, a number of differences between them. Among other characters, *Syrrhodia* can be separated by having setae L_1 and A_3 of the larval head in a horizontal plane, setae A_1 , A_2 , and Adf_1 in a straight line, seta O_2 on a level with the lower edge of ocellus 1, and seta P_1 lower than seta Adf_2 ; there are also differences in the setae of the thoracic segments. Unfortunately, nothing can be said at this time about the comparative morphology of the pupae, owing to lack of material.

The species included in the genus *Syrrhodia*, as here defined, can be separated into two groups, by both maculation and genitalia. One of these groups includes *esperanza* and *viridirufaria* (*Syrrhodia*, *sensu stricto*); the other, *cruentaria* and *sphaeromacharia* (*Catopyrrha*; genotype: *Erastria immista dissimilaria* Hübner, monobasic). The first of these shows a tendency for sexual dimorphism in the maculation of the adults within the species, with the possibility of seasonal dimorphism; the second group displays seasonal dimorphism in the maculation of the adults to a greater or lesser degree. In the genitalia, the two groups can be separated, in the male, by the shape of the aedeagus and the outline of the costal arms of the valves and, in the female, by the origin of the ductus seminalis. (Refer to couplet 1 of the keys to the genitalia for details.) The differences, if any, present in the early stages are unknown, as there is insufficient material at the present time for comparative purposes. In the light of our present knowledge it is believed that the above differences are not of generic value but might possibly be used in a subgeneric sense if desired.

The genus *Syrrhodia* is found from northern South America through Central America and the Antilles as far north as southern Canada but is lacking in the Pacific coast states in this country.

KEY TO ADULTS

1. Forewings above unicolorous dull pea green or deep flesh color, without maculation except for two red brown spots in distal half of wing completely or partially connected by band of same color extending from middle of wing to inner margin; expanse, 34 to 43 mm. *viridirufaria*
- Forewings above dark gray, olive green, light reddish brown, or yellow, maculation consisting of one to three cross lines beginning at costa and extending completely or partially across wing; expanse, 26 to 39 mm. 2
2. T. p. line of forewings above sharply defined or diffuse, arising on costa two-thirds to three-fourths distance from base, curving subparallel with outer margin. 3
- T. p. line of forewings sharply defined, arising on costa five-sixths distance from base, extending across wing in straight line, usually with two black spots distad of this but these sometimes reduced or absent *sphaeromacharia*
3. T. p. line of forewings above diffuse, sometimes faintly represented, evenly curved in both sexes; t. a. line usually absent or only vaguely indicated *cruentaria*
- T. p. line of forewings usually sharply defined and prominent, curved in male, waved in female; t. a. line present, distinct. *esperanza*

KEY TO MALE GENITALIA

1. Costal arms of valves not enlarged terminally, apex either pointed or hook-like; both ends of aedeagus tapered. 2
- Valves with costal arms enlarged terminally; aedeagus truncate anteriorly, posterior end produced into long sclerotized point. 3
2. Valves with costal region distad of costal arm heavily spined for one-half distance to apex; aedeagus not longer than combined length of tegumen and saccus, posterior end rounded. *esperanza*
- Valves without heavy spining distad of costal arms; aedeagus one and one-fourth times as long as length of tegumen and saccus, posterior end pointed. *viridirufaria*
3. Valves with costal arms symmetrical, terminal swelling projecting medio-posteriorly. *cruentaria*
- Valves with costal arms asymmetrical, left arm larger than right, terminal swelling projecting laterally. *sphaeromacharia*

KEY TO FEMALE GENITALIA

1. Ductus bursae ventrally with membranous band; ductus seminalis arising at junction of ductus bursae and bursa copulatrix. 2
- Ductus bursae ventrally with sclerotized median band; ductus seminalis arising from this sclerotized ring. 3
2. Bursa copulatrix short, subovoid, less than twice as long as wide; ductus bursae with sclerotized dorsal margin extending beyond ventral margin a distance equal to length of ventral surface of ductus bursae. *esperanza*
- Bursa copulatrix elongate, approximately three times as long as wide; ductus bursae with sclerotized ventral margin apparently extending farther posteriorly than dorsal margin. *viridirufaria*

3. Bursa copulatrix not extending anterior to segments IV or V.....*cruentaria*
 — Bursa copulatrix extending almost entire length of abdomen, much longer
 than wide.....*sphaeromacharia*

Syrrhodia decrepitaria Hübner

Syrrhodia decrepitaria HÜBNER, 1823, *Zuträge zur Sammlung exotischer Schmettlinge*, vol. 2, p. 29, figs. 371, 372; "1816" [1823], *Verzeichniss bekannter Schmetterlinge*, p. 300.

Unfortunately there is insufficient material at this time to undertake a complete study of the subspeciation of *decrepitaria*, although preliminary investigations suggest that some intraspecific variations do occur. A number of names have been placed in the synonymy of this species by various authors; however, until the types can be carefully checked, their status must remain more or less uncertain. The species apparently is distributed across the northern portion of South America, from Brazil, Ecuador, and Peru, through Central America and Mexico to southern Texas, and in the Antilles from Trinidad to Cuba. The specimens occurring in Texas are herein treated as the northern subspecies.

Syrrhodia decrepitaria esperanza (Barnes and McDunnough), new status

Figures 4A, 6A

Calopyrrha esperanza BARNES AND MCDUNNOUGH, 1917, *Contributions to the natural history of the Lepidoptera of North America*, vol. 3, p. 239, pl. 22, figs. 5, 6. FORBES, 1948, *Cornell Univ. Agr. Exp. Sta., mem.* 274, p. 71.

MALE: Head, vertex and front purplish pink, yellowish bordering eyes; palpi yellow, with increasing number of purplish pink scales terminally. Thorax above olive green, concolorous with forewings, ventrally yellow; legs, coxae yellow, remaining segments suffused with olive and pink scales, shading into olive gray terminally. Abdomen concolorous with thorax, olive green above, yellow below.

UPPER SURFACE OF WINGS: Forewings, ground color olive green, sparsely marked with olive brown scales; costa pink at base, concolorous with wing distally, crossed by numerous deep olive strigations in basal half, these fewer to obsolescent in distal half; t. a. line narrow, distinct, sometimes obsolescent, olive brown, often becoming orange brown posteriorly, arising on costa one-fourth distance from base, running obliquely outward into cell, sharply angled posteriorly with slight basal bend on vein

Cu, meeting inner angle with basal bend about three-tenths distance from base; median line broader, diffuse, often fading out before reaching inner margin, arising on costa one-half distance from base, forming diffuse patch in cell, turning posteriorly, and running subparallel with t. a. line; t. p. line narrow, distinct, olive brown, becoming purple brown or orange brown posteriorly, arising on costa at right angle two-thirds distance from base, going straight to vein M_1 , angled posteriorly, sometimes with slight basal bend to vein Cu_1 , turning subparallel with outer margin, meeting inner angle with outward bend four-fifths distance from base; subterminal area next to t. p. line deep olive green, darker than remainder of wing, becoming lighter again terminally, with a small blackish or red brown spot, often with few white scales above vein 2A near t. p. line, below this above inner margin a diffuse dark area; fringe concolorous with wing. Hind wings concolorous with forewings; antemedian line diffuse, olive brown to orange brown, going straight or being slightly convex across wing approximately one-half distance from base at costal and inner margins; t. p. line similar to that on primaries, curving with slight basal bend on vein Cu_2 , meeting inner margin at four-fifths distance from base; subterminal area as on forewings but without spots; fringe concolorous with wing.

UNDER SURFACE OF WINGS: Forewings, ground color yellow, lightly strigate with olive brown or purple brown scales; costa pink at base, crossed by numerous olive strigations; t. a. line absent; discal dot present, sometimes faint; median line absent in anterior half of wing, vaguely indicated in posterior half by diffuse groupings of darker scales; t. p. line prominent, as above; subterminal area concolorous with remainder of wing or broadly suffused with olive brown or red brown, becoming smoky brown posteriorly, with apex and margin relatively unsuffused; outer margin narrowly darkened; fringe concolorous with wing. Hind wings concolorous with forewings; antemedian line diffuse, faint, obsolescent in anterior half of wing; discal dot present, dark brown; t. p. line as on forewings; subterminal area as on forewings, when suffused with olive brown scales, terminal area largely yellow; outer margin and fringe as on primaries. Expanse: 26 to 33 mm.

FEMALE: Like male, except all wings above with cross lines fainter, t. p. line waved instead of being straight; spots above inner margin on forewing larger. Under surface usually more

contrastingly marked, all maculation being with red or orange brown scales; t. p. line waved as above. Expanse: 31 to 35 mm.

MALE GENITALIA: Uncus slightly tapering to apex; socius with from 12 to 16 hairs; gnathos rudimentary; valves elongate, narrow, costal region with elongate arm near base, in length approximately one-half that of tegumen, arms of two valves asymmetrical, arm of right valve narrowed medially, terminally bluntly pointed to sharply hooked, arm of left valve shorter and wider than right arm, terminally pointed or hook shaped; area basad of costal arm in form of small tubercle with from five to eight hairs; middle one-third of both valves in costa and valvula convex with large number of short heavy hairs, terminal portion curved posteriorly; transtilla with anterior projection rounded; saccus extending beyond base of valves a distance equal to width of aedeagus; aedeagus as long as combined length of tegumen and saccus, of greatest width medially, both ends tapering to rounded apices, vesica unarmed.

FEMALE GENITALIA: Ductus bursae slightly longer than length of ovipositor lobes, sclerotized dorsal surface approximately twice length of ventral surface, posterodorsal margin shallowly cleft medially, median band membranous; ductus seminalis from junction of ductus bursae and bursa copulatrix; bursa copulatrix slightly longer than dorsum of segment VII, obtusely pear-shaped, sometimes anterolaterally extended on right side, surface of posterior one-third with irregular longitudinal striations, remainder of surface smooth, internally with spermatophore somewhat transversely coiled, anteriorly swollen, terminally into irregularly shaped sac.

EARLY STAGES: Unknown.

TYPES: In United States National Museum. Described from one male and one female; these specimens illustrated with original description.

TYPE LOCALITY: Brownsville, Texas.

RANGE: Southern portion of Texas. It has been reported from Florida but this should be verified. (See fig. 1.) Very little data are available on the season of flight. The allotype is dated "7-11"; the only other definite date is October.

FOOD PLANT: Unknown.

REMARKS: Nineteen specimens examined. The species is easily distinguished from the others occurring in the United States by the fact that the t. p. line of the forewings is subparallel

with the outer margin of the wing and is curved in the male and waved in the female. This subspecies apparently tends to be more olivaceous and of a more uniform color than Mexican examples, although this character may not hold true when large series of both are obtained. All the Mexican examples studied have been from central Vera Cruz and Chiapas. This gap of approxi-



FIG. 1. Distribution of *Syrrhodia decrepitaria esperanza* (Barnes and McDunnough) and *S. viridirufaria* (Neumoegen).

mately 450 miles is probably due more to a lack of collecting in the intervening areas than to an actual discontinuity in the distribution of the species.

The genitalia of *esperanza* are quite distinctive when compared with the other species of this genus occurring in this country. The male can be recognized by the heavily spined area on the valves distad to the costal arms, and the female by the fact that the ductus seminalis arises at the junction of the ductus bursae

and bursa copulatrix, the bursa being relatively short and sub-ovoid, and by the shape of the ductus bursae.

Syrrhodia viridirufaria (Neumoegen), new combination

Figures 4B, 6B

Aspilates viridirufaria NEUMOEGEN, 1881, Papilio, vol. 1, p. 145.

Enemera (sic!) viridirufaria, DYAR, 1902, Bull. U. S. Natl. Mus., vol. 52, p. 318.

Sericosema viridirufaria, BARNES AND McDUNNOUGH, 1917, Check list, p. 115. CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 151.

Sericosema viridirufaria form ♀ *incarnata* BARNES AND McDUNNOUGH, 1917, Contributions to the natural history of the Lepidoptera of North America, vol. 3, p. 240.

MALE: Head, vertex and front pink, cream colored bordering eyes; palpi rose, with scattered whitish scales. Thorax above light green, concolorous with forewings, ventrally paler; legs with rose and pink scales, becoming cream gray on tarsi. Abdomen concolorous with thorax.

UPPER SURFACE OF WINGS: Forewings, ground color unicolorous dull pea green, very sparsely speckled with red brown and orange brown scales; costa rose or pink, sometimes shading into yellow distally; entire wing without maculation except for two red brown spots usually connected by band of same color in distal half of wing, uppermost spot located below vein M_3 about two-thirds distance from base, lower spot on vein 2A about three-fifths distance from base, extending from anal margin to middle of cell above, line connecting these slightly reduced medially with inner margin sharply defined, outer margin less sharply so; fringe, basal half concolorous with wing, terminal half pink. Hind wings green, heavily dusted with brown scales, or orange brown dusted with orange, pink, and brown scales; without maculation except for broad, indistinct, brownish postmedian line usually extending across wing approximately one-half distance from base, sometimes reduced or absent; fringe green or pink.

UNDER SURFACE OF WINGS: Ground color yellow, both wings usually heavily and evenly dusted with pink scales; primaries, costa chiefly without pink scales, wing without maculation except for faint, often obsolescent, discal dot and indistinct postmedian band two-thirds distance from base, extending subparallel with outer margin across wing, formed by concentration of pink scales, inner margin pale, fringe pink; secondaries concolorous with primaries, without maculation except for small pink discal

dot, rarely very faint postmedian line indicated; fringe as on primaries. Expanse: 34 to 40 mm.

FEMALE: Like male; ground color of wings above either green as in male or deep flesh color; line connecting spots on forewings incomplete or absent; hind wings less heavily dusted with dark scales, without indistinct postmedian line. Under surface less heavily dusted with pink scales, maculation obsolescent. Expanse: 40 to 43 mm.

MALE GENITALIA: Uncus tapering to apex; socius with from 12 to 16 hairs; gnathos rudimentary; valves, costal region with elongate pointed arm near base, in length approximately one-half that of tegumen, inner margin of arm at right angle to valve rarely with slight projection medially, outer margin at angle to valve with broad medial swelling between apex of arm and costal margin, this slightly more pronounced on left side; area basad of costal arm in form of slight swelling with from five to nine hairs; distal portion of valve without any heavy concentration of hairs; transtilla with anterior projection curved mediad; saccus projecting well beyond anterior margin of valves, anterior margin of valves halfway between junction of tegumen and anterior margin of saccus which is rounded; aedeagus very long, one and one-fourth times as long as combined length of tegumen and saccus, posterior end sclerotized, tapering to long sharp point, slightly constricted medially, vesica with sclerotized or scobinate patch.

FEMALE GENITALIA: Ductus bursae slightly shorter than length of ovipositor lobes, sclerotized area extending laterally to ostium, deeply cleft dorsally, median band membranous; ductus seminalis from junction of ductus bursae and bursa copulatrix; bursa copulatrix approximately one and one-half times length of dorsum of segment VII, elongate, widest medially, surface of posterior one-third irregularly wrinkled, finely punctate, remainder of surface smooth, internally with coiled and recoiled spermatophore.

EARLY STAGES: Unknown.

TYPES: *Viridirufaria*, United States National Museum type no. 34240; described from one female and one male. The male is in rather poor condition, while the female is in much better shape; the original description was apparently based primarily on this latter specimen, and it (the female) is hereby designated as lectotype. *Incarnata*, in United States National Museum.

TYPE LOCALITIES: Greenhorn Mountains, Colorado (*viridi-*

rufaria, type labeled "Col." only); Palmerlee, Cochise County, Arizona (*incarnata*).

RANGE: Colorado, New Mexico, and Arizona. (See fig. 1.) On the wing from May through August.

FOOD PLANT: Unknown.

REMARKS: Forty-four specimens examined. This species would be difficult to confuse with any of the others, owing to its larger size and coloration. Within the species, the maculation shows but slight differences, while the coloration is apt to be more variable. This latter is more apt to be expressed in the female, which appears in two color phases throughout the range of the species, as far as is known. One of these is green as in the male (typical *viridirufaria*), the other being a deep flesh color (form *incarnata* Barnes and McDunnough). Much more material is needed to determine the ratio of green forms to flesh-colored forms; apparently it is not seasonal dimorphism, as both forms occur in the same population at the same time.

The genitalia are also distinctive. The male can be separated by the pointed costal arms and the elongate nature of the aedeagus, and the female genitalia by the fact that the ductus seminalis arises from the junction of the ductus bursae and bursa copulatrix, together with the elongate shape of the bursa.

Syrrhodia cruentaria (Hübner), new combination

Figures 5A, 6C

Geometra cruentaria HÜBNER, "1796" [1796-1799], Sammlung Europäischer Schmetterlinge, Horde 5, pl. 10, fig. 48.

Aspilates cruentaria, TREITSCHKE, 1827, Schmetterlinge von Europa, vol. 6, p. 136. DUPONCHEL, 1830, Histoire naturelle des lépidoptères ou papillons de France, vol. 8, p. 128, pl. 179, fig. 8. GUENÉE, 1857, Histoire naturelle des insectes, vol. 10, p. 183.

Catopyrrha cruentaria, DYAR, 1902, Bull. U. S. Natl. Mus., vol. 52, p. 318.

Phalaena coloraria FABRICIUS, 1798, Supplementum, entomologiae systematicae, p. 452.

Aspilates coloraria, GUENÉE, 1857, Histoire naturelle des insectes, vol. 10, p. 183. PACKARD, 1876, A monograph of the geometrid moths... of the United States, pp. 206, 564, pl. 9, fig. 36. HULST, 1887, Ent. Amer., vol. 3, p. 10; 1895, Ent. News, vol. 6, p. 15.

Catopyrrha coloraria, WALKER, 1862, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 24, p. 1064. HOLLAND, 1903, Moth book, p. 343, pl. 43, fig. 54. GROSSBECK, 1912, Jour. New York Ent. Soc., vol. 20, p. 288, fig. 1 (male genitalia); 1917, Bull. Amer. Mus. Nat. Hist., vol. 37, p. 95. BRITTON, 1920, Check-list of the insects of Connecticut, State Geol. and Nat. Hist. Surv., bull. no. 31, p. 118. FORBES, 1928, in Leonard,

Cornell Univ. Agr. Exp. Sta., mem. 101, p. 610; 1948, Cornell Univ. Agr. Exp. Sta., mem. 274, p. 70.

Perconia coloraria, GUMPPENBERG, 1892, Nova Acta Deutschen Akad. Naturf., Halle, vol. 58, p. 279.

Erastria immista dissimilaria HÜBNER, "1806" [1813], Sammlung exotischer Schmetterlinge, vol. 1, [pl. 203].

Catopyrrha dissimilaria, HÜBNER, "1816" [1823], Verzeichniss bekannter Schmetterlinge, p. 301. WALKER, 1862, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 24, p. 1064.

Aspilates dissimilaria, GUENÉE, 1857, Histoire naturelle des insectes, vol. 10, p. 182. PACKARD, 1876, A monograph of the geometrid moths... of the United States, p. 208. HENRY EDWARDS, 1883, Papilio, vol. 3, p. 25. HULST, 1887, Ent. Amer., vol. 3, p. 10.

Perconia dissimilaria, GUMPPENBERG, 1892, Nova Acta Deutschen Akad. Naturf., Halle, vol. 58, p. 279.

Catopyrrha coloraria dissimilaria, DYAR, 1902, Bull. U. S. Natl. Mus., vol. 52, p. 318. HOLLAND, 1903, Moth book, p. 342, pl. 43, fig. 53. GROSSBECK, 1912, Jour. New York Ent. Soc., vol. 20, p. 288; 1917, Bull. Amer. Mus. Nat. Hist., vol. 37, p. 95. BRITTON, 1920, Check-list of the insects of Connecticut, State Geol. and Nat. Hist. Surv., bull. no. 31, p. 118. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., mem. 274, p. 70.

Crociphora accessaria HÜBNER, "1825" [1827-1831], Zuträge zur Sammlung exotischer Schmetterlinge, vol. 3, p. 26, figs. 503, 504.

Aspilates accessaria, GUENÉE, 1857, Histoire naturelle des insectes, vol. 10, p. 183.

Hyperitis ? accessaria, WALKER, 1862, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 26, p. 1501.

Catopyrrha accessaria, DYAR, 1902, Bull. U. S. Natl. Mus., vol. 52, p. 318.

Aspilates olenusaria WALKER, 1862, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 26, p. 1675. PACKARD, 1876, A monograph of the geometrid moths... of the United States, p. 211. HULST, 1887, Ent. Amer., vol. 3, p. 10; 1895, Ent. News, vol. 6, p. 15.

Catopyrrha coloraria olenusaria, DYAR, 1902, Bull. U. S. Natl. Mus., vol. 52, p. 318.

MALE: Head, vertex and front dark gray brown, the scales light gray distally, narrowly red brown bordering eyes; palpi brown with scattered black scales, gray dorsally. Thorax above concolorous with forewings, ventrally red brown to rust; legs, coxae concolorous with thorax, remaining segments with red brown, black, and gray scales. Abdomen concolorous with thorax.

UPPER SURFACE OF WINGS: Forewings, ground color dark gray to gray brown, often with very faint rosy suffusion, sparsely dotted with black brown scales; costa often narrowly pink crossed by numerous dark striae; t. a. line absent or obsolescent; when present, arising on costa one-fourth distance from base, running

obliquely outward into cell, curving posteriorly and hence to inner margin; median line obsolescent or absent; when present, represented by diffuse patch on costa one-half distance from base, extending into cell, then disappearing; t. p. line usually prominent, sometimes faint, diffuse black brown, arising on costa three-fourths distance from base, curving evenly subparallel with outer margin across wing to inner margin at two-thirds to four-fifths distance from base; subterminal area concolorous with remainder of wing, sometimes with diffuse blackish spot between veins M_3 and Cu_1 just distad of or adjoining t. p. line and with smaller spot adjoining t. p. line above inner margin, both spots very often absent; fringe concolorous or with distal half pink. Hind wings concolorous with forewings; antemedian line absent or obsolescent; postmedian line diffuse, faint, or obsolescent, going almost straight or slightly curved across wing, meeting inner margin three-fourths distance from base; subterminal area and fringe as on primaries.

UNDER SURFACE OF WINGS: Forewings, ground color red brown or orange brown, heavily strigate with black brown scales; t. a. and median lines absent, rarely the latter faintly suggested by clumps of dark scales; discal dot black brown, rounded; t. p. line broad, diffuse, prominent, as above but fading out above inner margin; subterminal area concolorous with remainder of wing, without spots of upper surface; fringe light gray or pinkish gray. Hind wings concolorous with forewings; antemedian line faint, diffuse, often obsolescent; discal dot prominent, black brown; postmedian line broad, diffuse, prominent, black brown, somewhat waved, subparallel with outer margin; subterminal area and fringe as on primaries. Expanse: 27 to 32 mm.

FEMALE: Like male, but tending to be slightly less heavily marked. Expanse: 26 to 32 mm.

The typical form, described above, is dark gray and flies during the spring months. Specimens from the northern part of the range are a fairly dark gray with darker maculation, while specimens from Florida tend to be more suffused with pink and with the maculation of the upper surface tending to be of this color. Hübner's figure of *cruentaria* is somewhat intermediate between these two extremes, the ground color of the wings being dark gray with a pink t. p. line. There is some variation in the presence or absence of the dark spots adjacent to the t. p. line; these appear in approximately one-half of the specimens studied.

The summer form, described as *dissimilaria* Hübner (*olenusaria* Walker), is similar to the above, but the gray ground color of the wings above is replaced by yellow, and varies from bright yellow to a dull yellow olivaceous. The maculation is similar, the cross lines being pink or reddish brown; the spots adjacent to the t. p. line in the subterminal area are nearly always absent. The under surface of both wings is also yellow and is heavily strigate and suffused with pink or red scales, being much more heavily suffused than in the spring form. The females are similar to the males. Expanse: males 27 to 36 mm., females 26 to 36 mm.

MALE GENITALIA: Uncus slightly tapering; socius with from nine to 18 hairs; gnathos obsolescent; valves, costal region near base with prominent arm, terminally projecting medio-posteriorly, both arms symmetrical, in length approximately two-thirds that of tegumen, arising from broad base, inner margin concave, outer margin with median ventral projection, concave between this and bluntly pointed apex, in thickness one-half to two-thirds width of aedeagus; area basad of costal arm scarcely swollen or slightly so, with from eight to 14 hairs; transtilla rounded medially; juxta broad, only slightly increasing in width posteriorly, anterior end narrowly cleft, posterior end broadly shallowly cleft; tegumen constricted in anterior third, anterior end narrower than width of aedeagus; saccus projecting beyond base of valves a distance less than width of aedeagus, anterior margin rounded; aedeagus approximately three-quarters combined length of tegumen and saccus, anterior end truncate, posterior end tapering to elongate sclerotized spine, vesica unarmed.

FEMALE GENITALIA: Ductus bursae slightly shorter than length of ovipositor lobes, sclerotized area extending laterally to ostium, dorsally with deep cleft, sclerotized ring extending laterally and ventrally from base of cleft, from whence ductus seminalis arises; bursa copulatrix approximately twice length of dorsum of segment VII, obtusely pear shaped, quite broad anteriorly, surface of posterior one-third with fine longitudinal striations and very small, inwardly pointing teeth, remainder of surface smooth or with occasional wrinkles, internally with one or two spermatophores somewhat transversely coiled anteriorly, enlarged terminally into elongate subovoid sac.

EARLY STAGES: The larvae have been briefly noted by Guenée and Forbes. As the latter author suggests, the earlier descriptions should be verified, as they may apply to either this species or

sphaeromacharia. Mr. Laurence R. Rupert has succeeded in rearing *cruentaria*; he has been kind enough to furnish the following notes:

LARVAE, UP TO FINAL INSTAR: "Greenish with many fine darker longitudinal lines. Between the two subdorsal dark lines the space is filled with darker color at the anterior end of each of

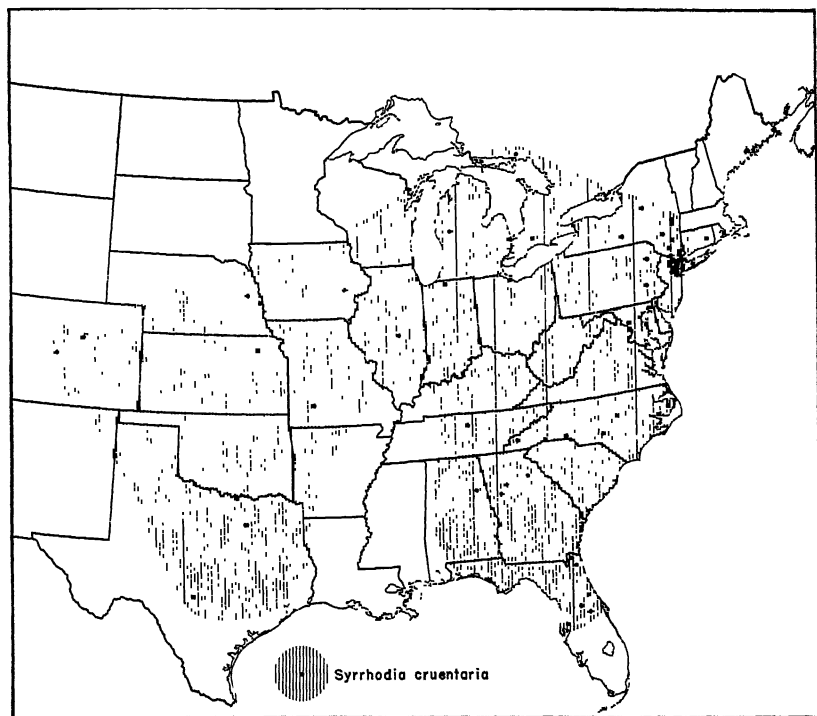


FIG. 2. Distribution of *Syrrhodia cruentaria* (Hübner).

the first five abdominal segments, giving the appearance of five dark dashes down the middle of the back."

FINAL INSTAR: "Head small and flat. Brownish, variable in color and pattern, but all with a dark mid-dorsal line or stripe, with many fine darker lines on each side of it. A pale lateral stripe extends uninterrupted from the last pair of prolegs to the mouth. Each abdominal segment has three small black tubercles on each side and two pairs of subdorsal ones; these show up better on the pale larvae. Beneath with many fine longitudinal lines. One

individual lacked the lateral stripe; some had dark brown patches and mottling in various patterns."

TYPES: Of *cruentaria*, *coloraria*, *dissimilaria*, *accessaria*, location unknown if still in existence; *olenusaria* in British Museum (Natural History).

TYPE LOCALITIES: None given (*cruentaria*, *dissimilaria*); North America (*accessaria*); Virginia (*coloraria*); east Florida, Georgia (*olenusaria*).

RANGE: Eastern and central United States and southern Canada, from the Atlantic Ocean to Colorado, and from Ontario and the Great Lakes region to Texas and Florida; no specimens or records have been seen from the lower Mississippi River Valley. (See fig. 2.) The spring form is on the wing from March through April or May (rarely as early as January in Florida); the summer form, from April or May through September; these dates vary with the latitude and season.

FOOD PLANTS: *Ceanothus americanus* Linnaeus. Reported (Guenée) on *Trifolium* and *Rubus* in the southern states; these records should be verified as they might conceivably be referable to *sphaeromacharia*, as it also occurs in this region.

REMARKS: Two hundred and eighteen specimens examined. Very little needs to be added to Grossbeck's separation (1912) of this species and *sphaeromacharia* Harvey. This species can be recognized by the marked seasonal dimorphism, and by the fact that the t. p. line of the forewings is diffuse and evenly curved subparallel with the outer margin.

The genitalia are also easy to recognize. Unfortunately, Grossbeck's preparations were rather crushed, and hence his drawings are somewhat distorted, although they suffice to separate *cruentaria* and *sphaeromacharia*. The male genitalia of this species differ from the others in the genus in that the costal arms of the valves are enlarged terminally and project medio-posteriorly, and in that the aedeagus is truncate anteriorly, with the posterior end produced into a long sclerotized point. The female genitalia can be recognized by the ventral median sclerotized band of the ductus bursae, with the ductus seminalis arising therefrom, and the short rounded bursa copulatrix. There are some indications that there may be some seasonal dimorphism in the female genitalia; much more material and further study are needed, however, before this can be definitely stated. In the gray-colored spring form, two out of the four genitalic prepara-

tions show two spermatophores; in all six preparations from the yellow-colored summer generation only a single spermatophore is present. Except for this character, the genitalia appear to be identical. There apparently are no obvious differences in the male genitalia between the spring and summer generations, although a fair amount of individual variation does occur.

The name *cruentaria* is used in preference to the better known *coloraria*, since Hemming (1937, Hübner, vol. 1, pp. 204, 268) has shown that plates 1 to 60 of Hübner's work were published sometime between the years 1796 and 1799. If these plates were issued consecutively, it seems probable that plate 10, on which *cruentaria* appeared, would have been published in the earlier part of this period, undoubtedly before the year 1798 when Fabricius published *coloraria*. It is unfortunate that a more definite date cannot be established for these plates, as there is always the possibility that *coloraria* was validated first; however, until this can be proved it seems advisable to accept the name *cruentaria*.

Syrrhodia sphaeromacharia (Harvey), new combination

Figures 5B, 6D

Crociophora coloraria var. *sphaeromacharia* HARVEY, 1875, Bull. Buffalo Soc. Nat. Hist., vol. 2, p. 284.

Aspilates coloraria var. *sphaeromacharia*, PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 207, pl. 9, fig. 35 (as *coloraria* var.).

Catopyrrha coloraria sphaeromacharia, DYAR, 1902, Bull. U. S. Natl. Mus., vol. 52, p. 318.

Catopyrrha sphaeromacharia, GROSSBECK, 1912, Jour. New York Ent. Soc., vol. 20, p. 288, fig. 2 (male genitalia); 1917, Bull. Amer. Mus. Nat. Hist., vol. 37, p. 95. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., mem. 274, p. 71.

Catopyrrha coloraria var. *perolivata* HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 340.

Catopyrrha coloraria var. *perolivaria*, PEARSALL, 1906, Sci. Bull. Brooklyn Inst. Arts and Sci., vol. 1, p. 207.

Catopyrrha sphaeromacharia var. *perolivata*, GROSSBECK, 1912, Jour. New York Ent. Soc., vol. 20, p. 288; 1917, Bull. Amer. Mus. Nat. Hist., vol. 37, p. 95. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., mem. 274, p. 71.

MALE: Head, vertex and front reddish purple, the scales light gray distally, yellowish bordering eyes; palpi yellow at base, becoming increasingly suffused with reddish purple and black scales terminally. Thorax above concolorous with forewings, ventrally yellow with pink scales; legs, coxae concolorous with thorax, remaining segments reddish purple with black scales, tarsi lighter. Abdomen concolorous with thorax.

UPPER SURFACE OF WINGS: Forewings, ground color varying from yellow through dull olive to light reddish brown, sparsely dotted with black brown scales; costa usually narrowly pink crossed by small dark striae; t. a. line narrow, distinct to occasionally obsolescent, olive brown to orange brown, arising on costa one-fourth distance from base, running obliquely outward into cell, turning sharply posteriorly, going straight to inner margin at one-third distance from base with slight basal bend below vein 2A; median line incomplete, represented by diffuse patch on costa, extending to vein M_1 , very rarely showing posteriad of this by scattered orange brown or dark brown scales; t. p. line narrow, distinct, black brown to orange brown, arising on costa five-sixths distance from base, going straight across wing to inner margin at three-fourths distance from base, sometimes with very slight outward curve below vein R_5 and with very slight basal bend below vein Cu_2 ; subterminal area next to t. p. line reddish purple to orange brown for about 1 mm., then fading back to ground color or appearing somewhat darker than remainder of wing, usually with round black spot between veins M_3 and Cu_1 just distad of t. p. line, often with second black spot adjoining t. p. line above inner margin, both spots may be reduced or absent; small dash at apex; fringe concolorous or red brown. Hind wings concolorous with forewings; t. a. line diffuse, reddish purple to orange brown, obsolescent near costa, curving to inner margin before one-half distance from base; median line prominent, similar to t. p. line of primaries with same distal shading, going straight across wing to inner margin two-thirds distance from base, sometimes with slight basal bends on veins R and Cu_2 ; t. p. line faint or absent, waved, subparalleling median line; outer half of wing slightly darker than basal half, rarely concolorous; fringe concolorous with wing.

UNDER SURFACE OF WINGS: Forewings, ground color yellow or orange brown, strigate with reddish purple scales; costa pink crossed by numerous olive strigations; antemedian line broad, diffuse, reddish purple, basad of discal dot, obsolescent near costal and inner margins; discal dot black brown, elongate; t. p. line prominent, as above, but sometimes slightly more curved, fading out above inner margin; subterminal area concolorous with remainder of wing, reddish purple shading along t. p. line or broadly suffused with reddish purple, sometimes completely shading costal half of area, posterior portion showing ground color in outer

half, black spots of upper surface faintly indicated or absent; fringe pink, becoming yellow posteriorly. Hind wings concolorous with forewings; t. a. line broad, diffuse, reddish purple, one-third distance from base on both costal and inner margins, strongly curved, confluent with black brown discal dot; median line narrow, faint, sometimes obsolescent, going straight across wing; t. p. line narrow, waved, reddish purple, arising on costa four-fifths distance from base, curving subparallel to outer margin, meeting inner margin five-sixths distance from base; subterminal area as on forewings; fringe pink, yellow along inner margin. Expanse: 27 to 37 mm.

FEMALE: Like male; t. p. line of hind wings above tending to be somewhat more prominent in some specimens. Expanse: 31 to 41 mm.

MALE GENITALIA: Uncus very slightly tapering; socius with from 18 to 32 hairs; gnathos obsolescent; valves, costal region near base with prominent arm enlarged distally, arm on left valve thicker and with larger terminal swelling than arm on right valve, both arms in length approximately one-half that of tegumen, arising from broad base, constricted medially with apex enlarged laterally, long axis of swelling parallel to long axis of valve, with pointed dorsal protuberance, arm of right valve with minimum thickness equal to one-third to one-half width of aedeagus, length of terminal swelling slightly shorter than, to subequal to, width of aedeagus, arm of left valve with minimum thickness and length of terminal swelling approximately one and one-half to twice that of right valve; area basad of costal arm in form of slight swelling with from five to 11 hairs; transtilla with anterior projection curving mediad; juxta broad, increasing in width posteriorly, posterior end broadly shallowly cleft; saccus projecting beyond base of valves a distance slightly less than width of aedeagus, anterior margin rounded; aedeagus slightly shorter than, or subequal to, combined length of tegumen and saccus, anterior end truncate, posterior end extending in form of elongate sclerotized blade, vesica armed with narrow, lightly sclerotized band extending approximately one-half circumference of aedeagus.

FEMALE GENITALIA: Ductus bursae slightly shorter than length of ovipositor lobes, ventral surface with median sclerotized lip produced posteriorly, from whence ductus seminalis arises; bursa copulatrix elongate, extending almost entire length of abdomen, surface finely wrinkled, usually arranged more or less

longitudinally, with very small, inwardly pointing teeth, internally with one or two elongate spermatophores somewhat coiled at posterior end with bursa correspondingly enlarged, running length of bursa, doubling back at anterior end for one-third length, terminating in large rounded sac.

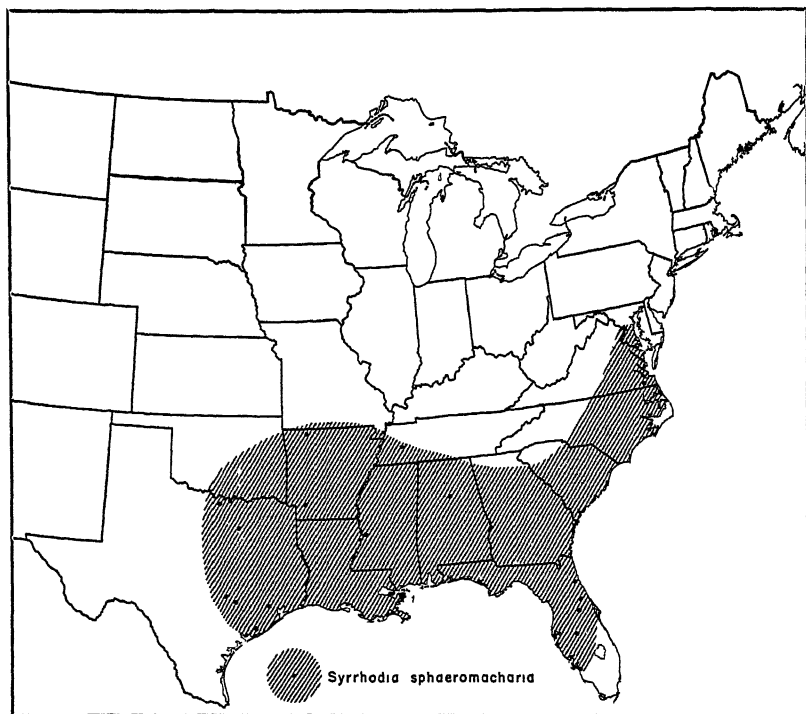


FIG. 3. Distribution of *Syrrhodia sphaeromacharia* (Harvey)

EARLY STAGES: Unknown.

TYPES: Of *sphaeromacharia*, location unknown; of *perolivata*, in Rutgers University.

TYPE LOCALITY: Alabama (*sphaeromacharia*); Texas (*perolivata*).

RANGE: Southeastern United States, from the District of Columbia to Florida and eastern Texas. (See fig. 3.) On the wing from April through September; probably at least two generations per year.

FOOD PLANT: Unknown.

REMARKS: Seventy-six specimens examined. This species can be recognized by the fact that the sharply defined t. p. line of the forewings arises on the costa about five-sixths the distance from the base and extends across the wing in an almost straight line, and by the continuation of this line across the hind wings. A considerable range of color is present in this species, and seasonal dimorphism may be indicated. However, if present, it is not nearly so marked as in *cruentaria*; much more accurately dated material is needed to settle this point. Forbes reports that the ground color varies from yellow to dull olive for most of the summer generation, and is reddish fuscous, more or less overlain with rosy, for most of the spring generation. There is also some variation in the size of the two black spots distad of the t. p. line on the forewings above; these may vary from large and prominent (typical *sphaeromacharia*) to partially reduced or completely absent (*perolivata*) in any population. Consequently, this latter name is not retained.

The specimen of *perolivata* bearing Hulst's type label in the Rutgers University collection has been examined. It is a male and is in good condition; it has no locality label. It agrees fairly well with the one sentence that constituted the original description; however, this specimen has a single, relatively small, black dot in cell M_3 distad to the t. p. line that is not mentioned in the description. The abdomen on this specimen has been glued on; a genitalic preparation has been made and it proves that this abdomen is definitely wrongly associated.

The genitalia are distinctive and easy to separate from the other species. Grossbeck's figure of the male genitalia was based on a crushed preparation, but the structures are nevertheless recognizable. The male can be distinguished by the asymmetrical costal arms of the valves, with the left arm being larger than the right one, and with the terminal swelling projecting laterally. The female genitalia are very distinct in having the very elongate bursa copulatrix. Some female preparations show one spermatophore while others have two; this might suggest a parallel variation with *cruentaria*, where the same phenomenon also occurs. Before this question can be answered, however, much more accurately dated material and study are needed.

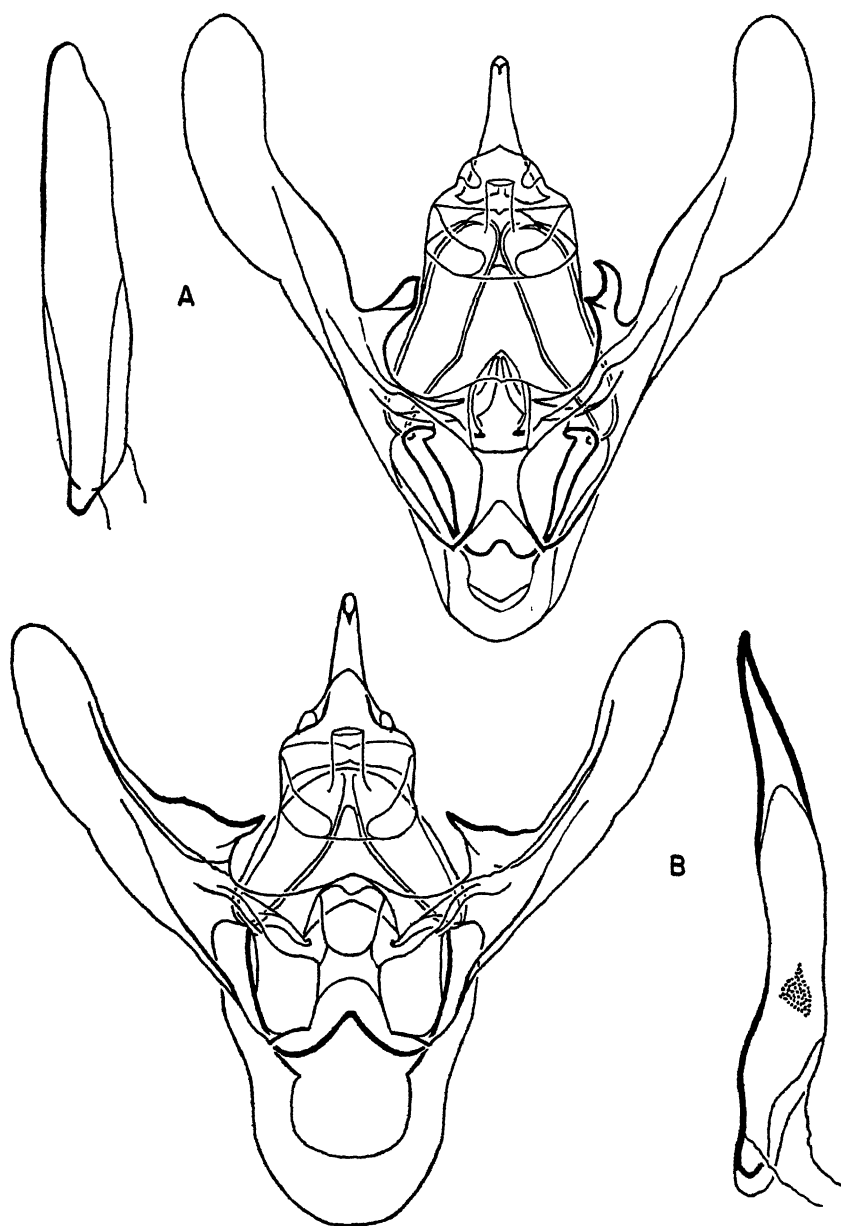


FIG. 4. Male genitalia of *Syrrhodia*. A. *S. decrepitaria esperanza* (Barnes and McDunnough), Texas. B. *S. viridirufaria* (Neumoegen), Palmerlee, Arizona.

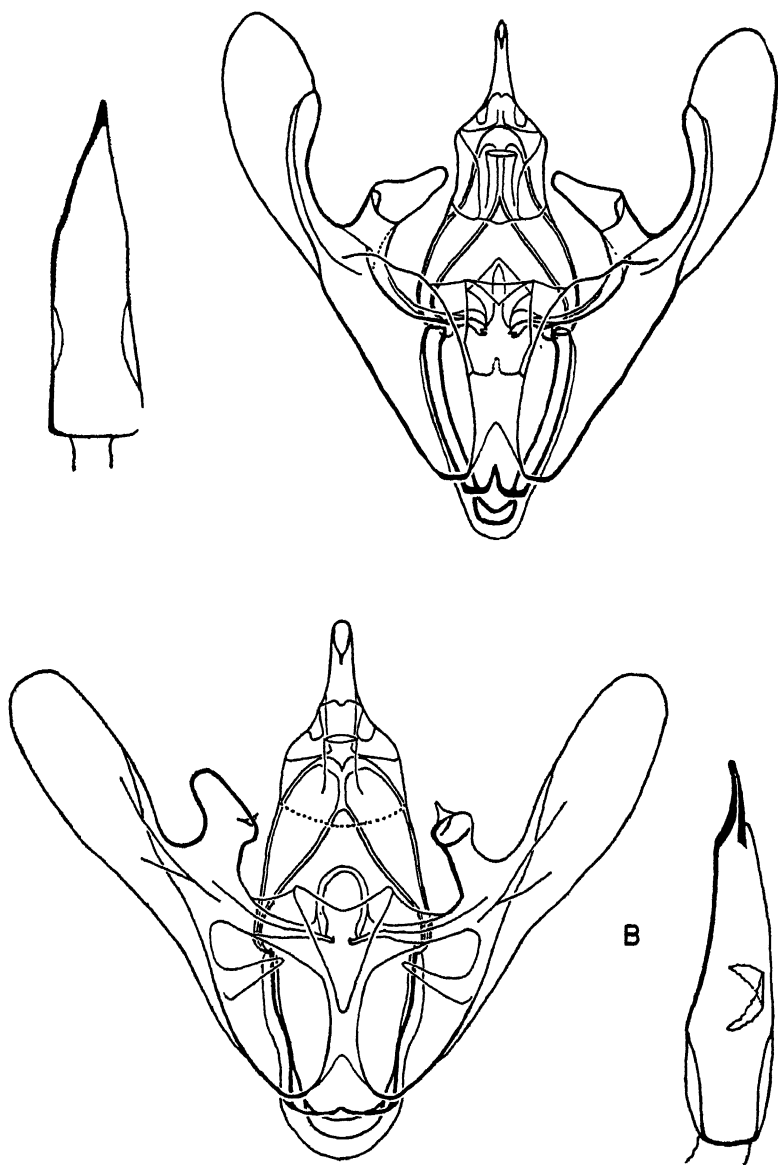


FIG. 5. Male genitalia of *Syrrhodia*. A. *S. cruentaria* (Hübner), Scranton, Pennsylvania, April 26, 1912 (M. Rothke). B. *S. sphaeromacharia* (Harvey), Birmingham, Alabama, August 8-9, 1916.

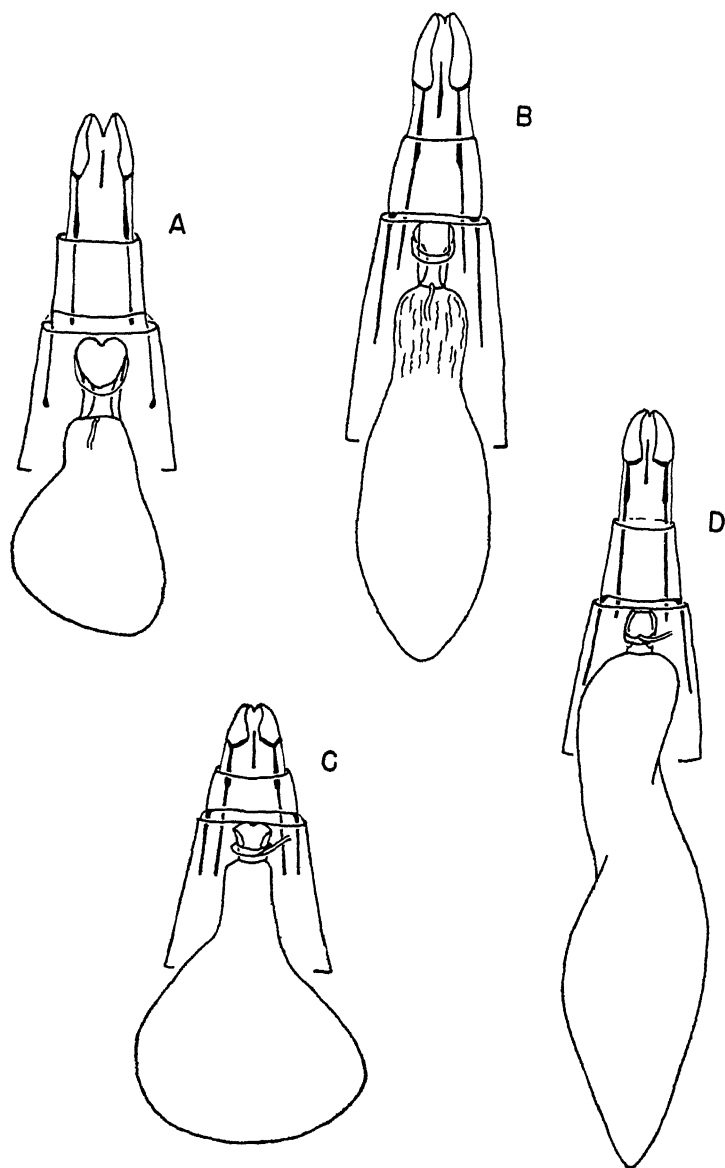


FIG. 6. Female genitalia of *Syrrhodia*. A. *S. decrepitaria esperanza* (Barnes and McDunnough), Brownsville, Texas, October 18, 1939 (collection of G. H. and J. L. Sperry). B. *S. viridirufaria* (Neumoegen), Gila County, Arizona, June 15-30, 1902 (O. C. Poling). C. *S. cruentaria* (Hübner), Plainfield, New Jersey, July 4. D. *S. sphaeromacharia* (Harvey), Florida, ex collection A. T. Slosson.

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SPIDERS OF THE RHOICININAE (PISAUROIDAE) FROM WESTERN PERU AND ECUADOR

BY HARRIET EXLINE¹

A small suite of spiders, collected in river valleys of coastal Ecuador and Peru, consists of one specimen of a new species of *Rhoicinus* Simon and several of the closely related new genus *Rhoicinaria* Exline. This material is the first to be recorded since Simon's proposal of the genus in 1898, and furnishes new data on the subfamily Rhoicininae.

The spiders of the Rhoicininae present a problem in family relationships. Their habits so far as known, as well as some morphological characters, relate them to the Lycosidae, where Simon placed them (1898, p. 129; 1898a, pp. 320-322). They build no webs, are ambulatory, and the female attaches her egg cocoon to the posterior spinnerets, appearing in life much like the lycosid *Pirata*. The eye arrangement, chelicerae, and pattern of the abdomen, however, relate the group to the Agalenidae, where Petrunkevitch (1928, pp. 9, 38; 1939, p. 166) included it. The group is little known, and no males have previously been described.

The morphological characters of the Rhoicininae are intermediate between those of the Agalenidae and Lycosidae. The group possesses characters, however, that exclude it from either family: It does not agree with the Lycosidae in (1) the possession of a colulus, (2) the integument covered with plumose hairs, (3) the eyes definitely arranged in two rows, (4) the lack of a tarsal scopula, (5) the possession of many teeth (9 to 20) on the upper claws, and (6) the divided anal tubercle. It differs from the

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Agalenidae in (1) the notched trochanters, (2) the trichobothria arranged in irregular double rows on the tibiae, metatarsi, and tarsi, (3) the lower claw with one or no teeth, (4) the divided anal tubercle, (5) the basal excavations of the labium, and (6) the attachment of the egg sac to the posterior spinnerets.

None of these characters is incompatible with those of the family Pisauridae. The Pisauridae, moreover, are intermediate in taxonomic position between the Lycosidae and Agalenidae. Several pisaurid genera have characters and/or habits in common with one or the other of these families. Consequently, the Rhoicininae are here placed in the family Pisauridae.

DISPOSITION OF TYPES: The holotypes and an allotype will be deposited at the American Museum of Natural History. A female paratype of *Rhoicinaria rorerae* will be given to each of the following institutions: the Museum of Comparative Zoölogy, Cambridge, Massachusetts; the British Museum (Natural History), London, England; the United States National Museum, Washington, D. C.; and the California Academy of Sciences, San Francisco, California.

ACKNOWLEDGMENTS: Miss Elizabeth B. Bryant, Museum of Comparative Zoölogy, Cambridge, Massachusetts, has very kindly supplied Simon's original description and checked the availability of the generic name *Rhoicinaria*. I am indebted to Messrs. Robin Walls and E. L. Moore, formerly of the Anglo-Ecuadorian Oilfields, Limited, Ancon, Ecuador, for the unique specimen of *Rhoicinus wallsi*.

FAMILY PISAURIDAE

SUBFAMILY RHOICININAE PETRUNKEVITCH (EMEND.)

Rhoicineae SIMON, 1898, Histoire naturelle des araignées, ed. 2, vol. 2, pp. 320-322, figs. 328-330 (a "group" within the Lycosidae).

Rhoicineae PETRUNKEVITCH, 1928, Trans. Connecticut Acad. Arts Sci., vol. 29, pp. 9, 38; 1939, *ibid.*, vol. 33, p. 166; (error for Rhoicininae; a subfamily of the Agalenidae).

DIAGNOSIS: Eyes in two nearly parallel rows, posterior row somewhat recurved; eyes of approximately equal size, or anterior median eyes a little smaller than others; upper claws bearing many teeth, lower claw one or none; integument covered with plumose hairs; no onychium or scopula on legs; three teeth on lower margin of fang furrow. Female attaches egg cocoon to posterior spinnerets.

COMPARISONS: The subfamily, as defined, most nearly agrees with the Thaumasiinae Petrunkevitch ("group" Dolomedae Simon). It can be separated from that subfamily only by a combination of characters: (1) absence of scopulae, (2) eyes almost equal in size, and in nearly parallel rows, (3) three teeth on lower margins of fang groove, (4) inflexible tarsi, (5) single or no tooth on third claw, (6) lack of marked secondary sexual dimorphism, and (7) rather flat carapace, with cephalic part having almost parallel sides.

GENUS *RHOICINUS* SIMON, 1898

Rhoicinus SIMON, 1898, Bull. Soc. Ent. France, no. 5, p. 129; 1898, Histoire naturelle des araignées, ed. 2, vol. 2, p. 322. PETRUNKEVITCH, 1928, Trans. Connecticut Acad. Arts Sci., vol. 29, p. 96.

GENOTYPE: *Rhoicinus gaujoni* Simon (1898, p. 129), by subsequent designation (Simon, 1898a, p. 322).

DIAGNOSIS: Cephalothorax oval, rather low, cephalic part with almost parallel sides, nearly straight in front; eyes almost equal in size, forming two nearly parallel rows; anterior row slightly recurved, eyes close together; posterior row wider, very slightly recurved; clypeus higher than diameter of anterior eyes; chelicerae with three teeth on lower margin of fang groove; labium longer than wide, more than half as long as maxillae; legs long, with many spines, without scopulae but with many long, bristle-like hairs; upper claws with many teeth (12-14), lower claw with one or none; upper spinnerets a little longer and more slender than anterior spinnerets, with apical segment shorter than basal.

REMARKS: Simon described two species of *Rhoicinus*. *R. gaujoni* is known only from the province of Zamora, Ecuador, in the southeastern part of the country and in the trans-Andean area recently ceded to Peru. *R. wapiéri* is recorded only from Colonia Tovar, Venezuela. The discovery of *R. wallsi* adds coastal Ecuador to the range of the genus and confirms its taxonomic unity.

Rhoicinus wallsi, new species

Figures 6-8

FEMALE: Total length, 7.83 mm.; length without chelicerae or spinnerets, 6.75 mm.; length of carapace, 3.15 mm.; width of

carapace, 2.34 mm.; width at level of posterior eye row, 1.62 mm.; maximum height of carapace, 1.05 mm.

Carapace reddish brown, narrowly outlined in black, with longitudinal thoracic groove and narrow radiating markings dark brown. Sides of carapace heavily pigmented with dark gray, leaving lighter patches near lateral margins, and a wide median longitudinal band heavily covered with inconspicuous, short, white hairs, and a few long, black, bristle-like hairs. Chelicerae dark reddish brown, covered with long bristles. A stout bristle between anterior median eyes, and a row of bristles directed medially on lower margin of clypeus. Legs and palps orange yellow, a little darker towards tip, annulate with gray, darker on under side of legs. Mouth parts and sternum yellow, suffused with indistinct gray markings. Sternum with long, perpendicular, gray bristles. Abdomen dark gray, with light yellowish basal marking; covered with bristles, dark hairs, and slender white plumose hairs that lie prone. Venter yellowish gray; genital area reddish; spinnerets yellow.

Chelicerae well developed, 1.62 mm. long, protruding somewhat in front of carapace, slightly geniculate; boss conspicuous; fang evenly rounded, of moderate length; fang groove with three well-developed teeth on each margin, upper margin scopulate. Carapace almost evenly rounded from cephalic grooves to posterior margin; cephalic region separated from thoracic by shallow cephalic grooves, not joining thoracic groove; cephalic region with sides almost parallel, quite blunt in front; clypeus vertical, 0.26 mm. high, one and a half times as high as diameter of anterior median eyes. Anterior eye row somewhat recurved in front view; posterior eye row slightly recurved in dorsal view; eyes almost equal in size, all appear dark; lateral eyes, especially posterior lateral, on low tubercles and facing laterally. Diameter of eyes: A.M.E., 0.17 mm.; A.L.E., 0.17 mm.; P.M.E., 0.17 mm.; P.L.E., 0.16 mm. Distance between eyes: A.M.E., 0.08 mm.; A.M.E. to P.M.E., 0.13 mm.; P.M.E., 0.12 mm.; A.M.E. to A.L.E., 0.03 mm.; P.M.E. to P.L.E., 0.20 mm.; A.L.E. to P.L.E., 0.15 mm. Quadrangle of median eyes a little narrower in front than behind, slightly longer than broad.

Maxillae scopulate on distal inner margins, 0.22 mm. long, normal in shape. Labium rather flat, over half length of maxillae, 0.14 mm. long and 0.12 mm. wide, a little longer than broad; basal excavations not exceeding half length of labium. Sternum

heart shaped, longer than wide, produced between hind coxae, which nevertheless are quite close together.

Lorum of pedicel somewhat similar to that of *Dolomedes*, although not so deeply notched.

Legs long and slender, 4123, without much disparity in length, without scopulae, spinose and covered with several kinds of hairs; trichobothria numerous on tarsi, in at least two irregular rows (so generally broken from tibiae and metatarsi of holotype that pattern is difficult to determine). Trochanters deeply notched. Three claws; upper two pectinate in a single row of 12 to 13 long, closely set teeth; distal seven or eight teeth about the same length, basal few shorter. Lower claw fairly large, curved, with long, slender, curved tooth. Measurements of legs in millimeters:

	FEMUR	PATELLA-TIBIA	METATARSUS	TARSUS	TOTAL
Palp	1.26	0.62 0.81	—	1.53	4.22
1	3.24	4.05	2.88	1.62	11.79
2	3.26	4.05	2.88	1.53	11.72
3	2.70	3.24	2.43	1.26	9.63
4	3.42	4.01	3.51	1.71	12.65

SPINATION OF LEGS

LEG 1: Femur: dorsal, 6 (weak, irregularly placed); prolateral, 2 distal. Patella: dorsal, 1; prolateral, 1; retrolateral, 1; (all weak). Tibia: dorsal, 2; prolateral, 2; ventral, 3 pairs (distals weak); retrolateral 2 (weak). Metatarsus: prolateral, 1-1 pair; ventral, 3 pairs; retrolateral, 2.

LEG 2: Femur: dorsal, 3 (weak); prolateral, 3 (weak); retrolateral, 3 (weak). Patella: none certain. Tibia: prolateral, 2; ventral, 2 pairs-1; retrolateral, 2. Metatarsus: dorsal, 1 distal; prolateral, 3; ventral, 3 pairs; retrolateral, 2; (whorl of 4-5 spines near distal end).

LEG 3: Femur: dorsal, 3 (weak); prolateral, 4 (weak); retrolateral, 2 (weak). Patella: prolateral, 1; retrolateral, 1. Tibia: dorsal, 1 (weak); prolateral, 2; ventral, 2 pairs; retrolateral, 2. Metatarsus: dorsal, 1 pair distal; prolateral, 3; ventral, 2 pairs-1; retrolateral, 3; (whorl of 5 near distal end).

LEG 4: Femur: dorsal, 3; prolateral, 3 (very weak); retrolateral, 1 (weak). Patella: dorsal, 1; prolateral, 2; retrolateral, 1 (weak). Tibia: dorsal, 2; prolateral, 2; ventral, 3 (weak); retrolateral, 2. Metatarsus: dorsal, 1 pair distal; prolateral, 4; ventral, 2 pairs staggered, 1 distal; retrolateral, 3; (whorl of 5 at distal end). (Some spines are missing on holotype, and spine scars are not well enough differentiated from long hair scars to allow an accurate count.)

Abdomen oval, narrow, deep; anal tubercle two segmented. Spiracular groove near spinnerets. Colulus short and broad. Anterior spinnerets a little shorter and thicker than posterior pair, with short conical terminal segment; median pair long; posterior

pair longest with terminal segment nearly as long as basal segment, with many spinning tubes on inner side. Genital area covered with reddish chitin, differentiated but not sclerotized; conspicuously covered with very long, soft, white hairs; genital plate protruding posteriorly over genital groove; no atrium or external openings visible. In posterior half of genital plate a pair of heavy, longitudinal, brown, and somewhat raised parts visible through external chitin; slightly converging posteriorly; probably consisting of short, thick connecting canals posteriorly, and small spermathecae anteriorly (see fig. 8).

LOCALITY: Ecuador, Province of El Oro: along the Colorado River, November 4, 1942, E. L. Moore and R. Walls (holotype female).

COMPARISONS: *Rhoicinus wallsi* is quite similar to *R. gaujoni* Simon, described from Zamora in the southeastern part of Ecuador. It differs from Simon's species, as described, in several characters: The proportions of the legs are different, the fourth being the longest in *wallsi*, whereas the first and fourth are equal (or the first slightly longer) in *gaujoni*. The clypeus is not so high in *wallsi* as in *gaujoni*, in which the height of the clypeus is nearly as great as the width of the eye area. The species occur in distinct areas, separated by the Andes Mountains, and at considerably different elevations, *wallsi* having been collected near sea level.

The species agrees quite well with the descriptions of *R. wapieri* Simon. It differs, however, in having a lower clypeus. The female genital plate is conspicuous, whereas Simon described that of *wapieri* as not at all prominent. Because of the extremely brief description of *R. wapieri*, as well as the distance separating the known occurrences of the species, *R. wallsi* is provisionally regarded as specifically distinct.

RHOICINARIA, NEW GENUS

GENOTYPE: *Rhoicinaria rorerae*, new species.

DIAGNOSIS: Similar to *Rhoicinus* Simon. Carapace about one-third longer than wide; height of clypeus no greater than diameter of anterior eyes; anterior median eyes a little smaller than other eyes; posterior eye row wide and considerably recurved; labium wider than long; leg 4 about three times length of carapace, longer than other legs; palp long, with narrow and shallow cymbium; tibia with short spur on outer side; embolus short and

terminal, on outer side of bulb; spermathecae of female very large, with openings into connecting canal on posterior margin of genital plate.

COMPARISONS: *Rhoicinaria* differs from *Rhoicinus* in being smaller, with shorter legs; carapace wider in proportion to length; clypeus lower; anterior median eyes smaller; posterior eye row more recurved; labium wider than long; female spermathecae larger.

Rhoicinaria rorerae, new species

Figures 1-5, 9-14

MALE: Total length, 3.06 mm.; length of carapace, 1.53 mm.; width of carapace, 1.04 mm.; height of carapace, 0.62 mm.

Carapace darker than that of female allotype, but not darker than in some other females; light reddish brown, with indefinite gray markings. Chelicerae dark reddish brown, mouth parts and sternum reddish yellow. Legs with femora and patellae lighter than cephalothorax, distal segments about same color as cephalothorax, very indefinitely annulated. Abdomen dark gray, with fairly definite yellowish markings; median basal marking not so definite as in female, succeeded by five pairs of median yellowish spots that coalesce into chevrons posteriorly; a few yellowish streaks on sides; venter and spinnerets yellowish. Abdomen covered with ordinary hairs and prone plumose hairs.

Cephalothorax as in female, except that cephalic part is not so distinctly set off, and chelicerae protrude only slightly in front of carapace and are scarcely if at all geniculate; clypeus vertical, 0.04 mm. high. Anterior row of eyes straight; posterior row moderately recurved and longer than anterior row; eyes appear light in color except anterior median eyes, which appear dark and are smaller than others; anterior median eyes farther from each other than from anterior laterals; posterior median eyes almost a diameter apart, not so far from posterior lateral eyes; median ocular area wider behind than long. Diameter of eyes: A.M.E., 0.06 mm.; A.L.E., 0.09 mm.; P.M.E., 0.08 mm.; P.L.E., 0.08 mm. Distance between A.M.E., 0.03 mm.; P.M.E., 0.07 mm.; A.M.E. to P.M.E., 0.04 mm.; A.M.E. to A.L.E., 0.01 mm.; P.M.E. to P.L.E., 0.05 mm. Mouth parts and sternum as in female; labium wider than long. Sternum heart shaped, 0.72 mm. long and 0.62 mm. wide.

Legs fairly long, spinose, with many long coarse hairs, short hairs, and plumose hairs; ventral side of femora clothed with an irregular double row of spine-like hairs, perpendicular to segment; three claws, upper two similar, pectinate with a single row of nine or 10 teeth on basal two-thirds, longer towards tip; third claw fairly long, geniculate, with one tooth or none; lacking scopulae, claw tufts, serrated bristles, and accessory claws, but with many long, spine-like hairs; trichobothria in two irregular rows on tibiae, metatarsi, and tarsi, longer towards tip of segments; no tarsal organ; without onychium. Trochanters notched, but not so noticeably as in female. No great disparity in length of legs, 4123. Measurements of legs in millimeters:

	FEMUR	PATELLA-TIBIA	METATARSUS	TARSUS	TOTAL
Palp	0.60	0.24 0.26	—	0.56	1.66
1	1.17	1.35	0.98	0.63	4.13
2	1.08	1.22	0.90	0.58	3.78
3	1.03	1.22	0.90	0.54	3.69
4	1.22	1.62	1.22	0.63	4.69

SPINATION OF LEGS

LEG 1: Femur: dorsal, 2; prolateral, 2. Patella: 1 distal, dorsal (?). Tibia: prolateral, 2; ventral, 3 pairs. Metatarsus: dorsal, 1 pair distal; prolateral, 1; ventral, 3 pairs (distal spines quite lateral).

LEG 2: Femur: dorsal, 2. Patella: dorsal, 1 distal (?). Tibia: prolateral, 2, ventral, 3. Metatarsus: dorsal, 1 distal; prolateral, 2; ventral, 2 pairs and 1 distal; retrolateral, 2.

LEG 3: Femur: dorsal, 2; prolateral, 1 distal (small); retrolateral, 1. Patella: dorsal, 1. Tibia: dorsal, 2; prolateral, 2; ventral, 1-1 pair; retrolateral, 2. Metatarsus: prolateral, 1-1-2; ventral, 2 pairs, 1; retrolateral, 1-2.

LEG 4: Femur: dorsal, 2 (?); retrolateral, 1 distal. Patella: dorsal, 1 distal (?). Tibia: dorsal, 2; prolateral, 2; ventral, 2; retrolateral, 2. Metatarsus: dorsal, 1 basal (weak); prolateral, 1-1-2; ventral, 1-1; retrolateral, 1-1-2. (Spines arranged in whorls of five near distal ends of metatarsi.)

Palp long; tibia slightly longer than patella; tibia bearing small blunt spur on distal retrolateral side; spur with a shallow, crescent-shaped, darkly chitinized excavation at ventral side of base; cymbium long, shallow, with thick bulb greatly protruding ventrally; visible part of bulb mostly tegulum, with one complete whorl of wide seminal duct visible through chitin; seminal receptacle in subtegulum, visible only between prolateral margin of cymbium and tegulum; embolus short, almost straight, on retrolateral terminal side of bulb, accompanied by very slightly

chitinized conductor arising from tegulum; a short, hooked, median apophysis present, arising from tegulum on prolateral terminal end; a heavily chitinized, inarticulated ridge visible between median apophysis and embolus, in center of terminal end of tegulum.

Abdomen like that of female, but lacking tufts of hairs at sides below genital furrow. Spiracular opening near spinnerets. Spinnerets and anal tubercle as in female.

FEMALE: Total length, 4.01 mm.; length, not including chelicerae or spinnerets, 3.96 mm.; length of carapace, 1.44 mm.; width of carapace, 1.17 mm.; width of cephalic part at posterior eye level, 0.68 mm.; height of carapace, 0.54 mm.

Carapace and chelicerae orange yellow, becoming a little paler posteriorly, with a few irregular gray markings on head and sides; margin of carapace narrowly outlined in black. Legs yellow, with faint gray annulations, becoming darker towards tip. Abdomen yellowish gray, with a few irregular gray markings, clothed with ordinary hairs and plumose hairs.

Carapace with sides rounded; cephalic region separated by shallow cephalic grooves, sides almost parallel; highest in front of thoracic groove; thoracic groove well marked, longitudinal.

Chelicerae robust, somewhat geniculate, with a well-developed boss at base, directed anteriorly and ventrally, somewhat divergent at tip, 0.72 mm. long; fang of moderate length; furrow of fang with three teeth on each margin, upper margin lightly scopulate. Clypeus vertical, 0.06 mm. high. Eyes in two rows, both recurved in dorsal view, rows almost straight in front view; eyes appear light, except anterior medians. Dimensions of eyes: A.M.E., 0.05 mm.; A.L.E., 0.09 mm.; P.M.E., 0.09 mm.; P.L.E., 0.08 mm. Distance between A.M.E., 0.05 mm.; A.L.E. to A.M.E., 0.02 mm.; A.M.E. to P.M.E., 0.04 mm.; P.M.E., 0.09 mm.; P.M.E. to P.L.E., 0.08 mm.; A.L.E. to P.L.E., 0.06 mm. Maxillae of moderate size, wider at tip than at base, 0.45 mm. long, scopulate on inner margin and inner half of anterior margin; labium, 0.20 mm. high, 0.26 mm. wide, basal excavations extend almost half length. Sternum heart shaped, 0.80 mm. long, 0.72 mm. wide, extending well between hind coxae.

Pedical with divided lorum, notched on posterior margin of anterior half, and lobed on anterior margin of posterior part.

Legs as in male, except that trochanters are very noticeably notched. Measurements in millimeters:

	FEMUR	PATELLA-TIBIA	METATARSUS	TARSUS	TOTAL
Palp	0.63	0.34 0.36	—	0.65	1.98
1	1.44	1.80	1.17	0.68	5.09
2	1.35	1.62	1.08	0.63	4.68
3	1.26	1.44	0.99	0.60	4.29
4	1.62	1.98	1.56	0.72	5.88

SPINATION OF LEGS

LEG 1: Femur: dorsal, 2; prolateral, 2 distal; retrolateral, 2. Patella: dorsal, 1 distal. Tibia: dorsal, 2 (weak); prolateral, 1 (weak); ventral, 3 pairs (strong), none distal. Metatarsus: ventral, 3 pairs (third pair lateral).

LEG 2: Femur: dorsal, 2; prolateral, 1 distal. Patella: dorsal, 1. Tibia: dorsal, 1 (weak); prolateral, 1; ventral, 3 pairs (those on prolateral margin very weak). Metatarsus: prolateral, 2; ventral, basal pair with prolateral weak, middle pair normal (distal pair considered prolateral and retrolateral); retrolateral, 1.

LEG 3: Femur: dorsal, 3; prolateral, 1. Patella: dorsal, 1 basal (weak), 1 distal. Tibia: dorsal, 2; prolateral, 2; ventral, 1 basal, 1 median pair; retrolateral, 1. Metatarsus: dorsal, 1 pair distal; prolateral, 2; ventral, 3 pairs; retrolateral, 2; (spines in whorl of 5 near distal end of segment).

LEG 4: Femur: dorsal, 3. Patella: dorsal, 1. Tibia: dorsal, 2; prolateral, 2; ventral, 1 basal, 1 pair median; retrolateral, 2. Metatarsus: prolateral, 1 basal, 1 median, 1 pair distal; ventral, basal pair staggered, median pair staggered, 1 distal; retrolateral, 1 basal, 1 median, 1 pair distal.

Palp quite long and robust, with pectinate claw.

Abdomen steeply rounded, longer than wide. Spiracle near spinnerets. Spinnerets six; first pair most robust, with a small conical second segment; posterior pair slender, but longer than anterior pair, with a conical second segment. Anal tubercle, seen from above, large and two-segmented, basal segment much wider than terminal.

Genital plate large, strongly arched; no atrium or openings visible from ventral surface; posterior edge heavily chitinized, extending posteriorly over genital groove, similar to genitalia in the lycosid *Pirata*. A pair of very large oval spermathecae show through the chitin, almost contiguous along medial line. Openings separated, situated beneath posterior edge of plate, each leading into a connecting canal and into large spermatheca. Fertilization ducts drain connecting canals almost at exterior openings, turning dorsally and anteriorly to vagina. (Internal details from cleared preparations; see figures.)

LOCALITIES: Ecuador, Province of Guayas: Hacienda San Miguel, Milagro, May 10, 1942 (holotype male, two female paratypes, one immature male).

Peru, Department of Piura: Sullana, November 12, 1939 (one male and two female paratypes), October 5, 1941 (allotype female, several female paratypes); Hacienda Mallares, along Chira River, January 4, 1941 (one female paratype), January 26, 1941 (three female paratypes); along Chira River (no locality or date) (two female paratypes).

All of these specimens were collected by H. E. and D. L. Frizzell.

ECOLOGY: *Rhoicinaria rorerae* is a tropical spider, restricted to a moist environment. It is known only in river valleys, and recorded occurrences are at elevations near sea level.

The species lives on the ground, in vegetable debris and the floor litter of open wooded areas. It inhabits banana groves at Milagro, Ecuador, and at Sullana, Peru. In the latter area, along the Chira River, it was collected most frequently in swampy, uncultivated terrain that received the overflow from an irrigation ditch.

Rhoicinaria rorerae apparently makes no web of any kind. It is ambulatory in habit. The female carries a lenticular egg sac attached to the posterior spinnerets. No egg sacs were preserved for study.

Mature specimens were collected in Peru in October, November, and January, and in Ecuador in May. Probably several generations develop during a year.

REMARKS: The species is named in honor of Mrs. James B. Rorer, Hacienda San Miguel, Milagro, Ecuador.

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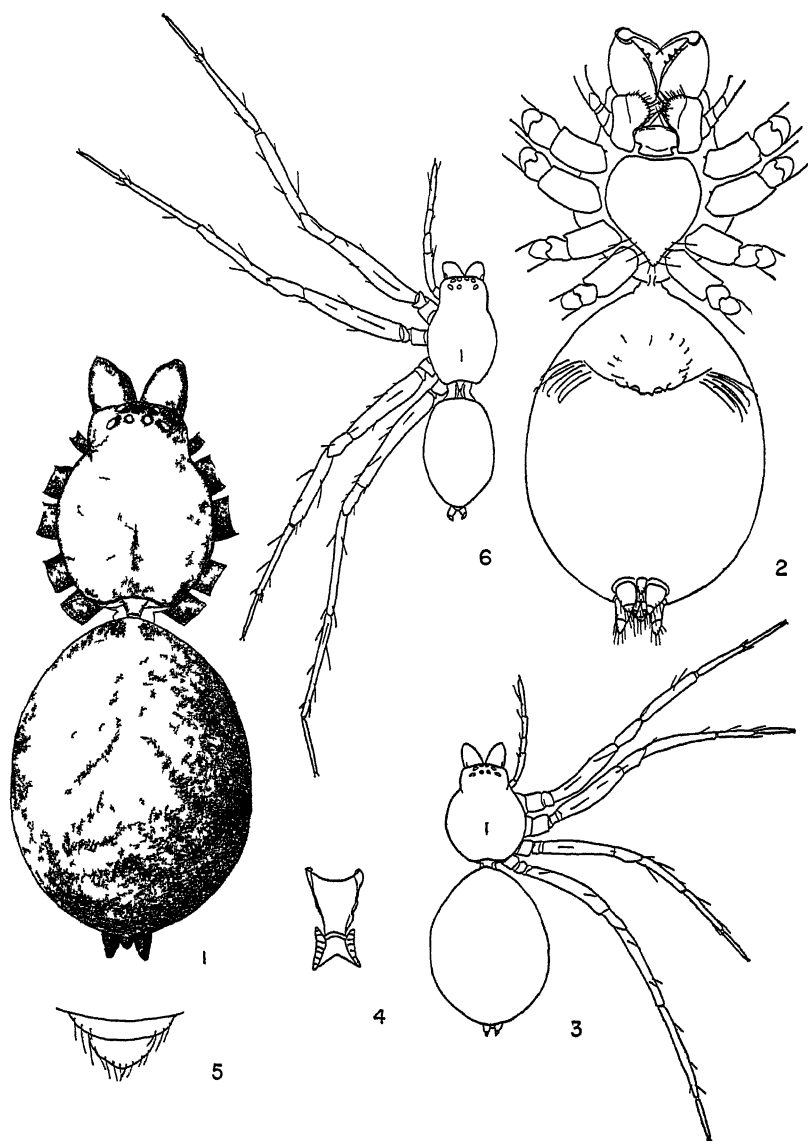
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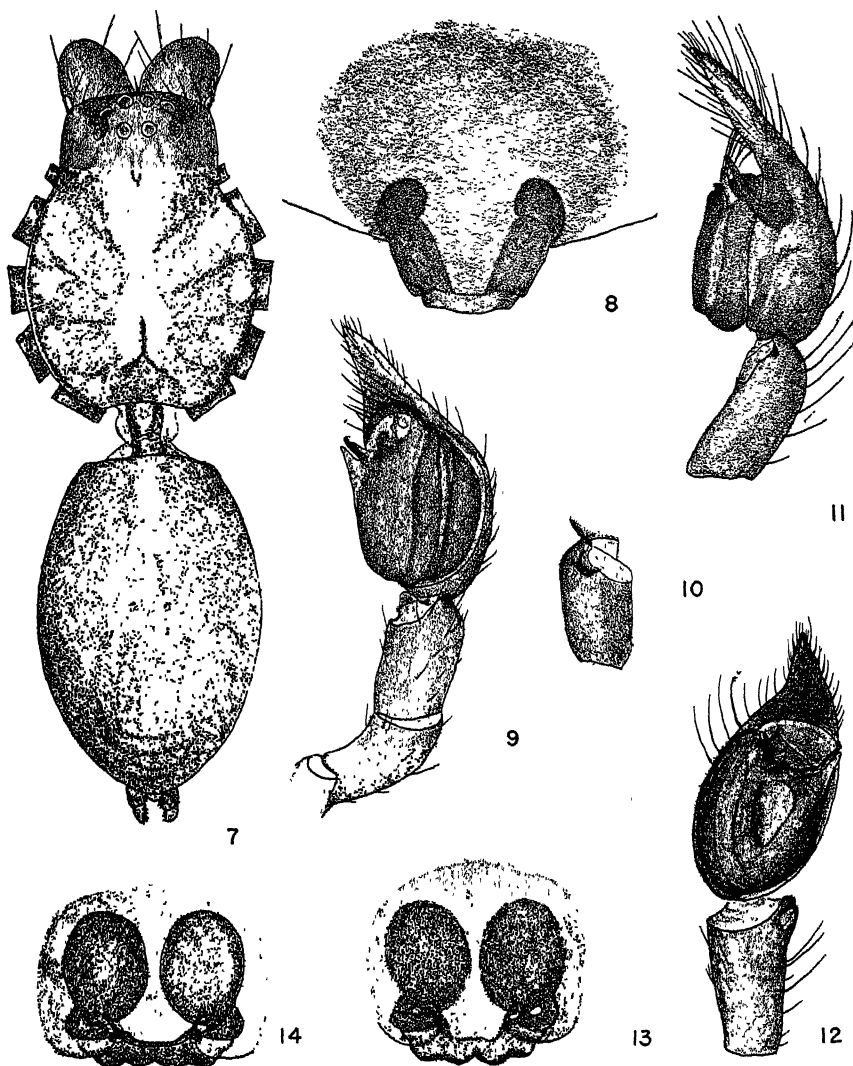
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FIGS 1-5 *Rhoicinaria rorerae*, new species, female allotype and paratype, Sullana, Department of Piura, Peru 1, 3 Dorsal views, allotype 2 Ventral view, allotype 4 Lorum of pedicel, dorsal view, paratype 5 Anal tubercle, dorsal view, paratype

FIG 6 *Rhoicinaria wallsi*, new species, holotype, Colorado River, Province of El Oro, Ecuador, dorsal view



FIGS. 7, 8. *Rhoicinus wallsi*, new species, holotype. 7. Dorsal view. 8. Genital plate, ventral view.

FIGS. 9-14. *Rhoicinaria rorerae*, new species. 9, 10. Male holotype, Milagro, Province of Guayas, Ecuador. 9. Right palp, prolateral view. 10. Tibia of right palp, retrolateral view. 11, 12. Paratype male, Sullana, Peru. 11. Left palp, retrolateral view. 12. Left palp, ventral view. 13, 14. Paratype female, Sullana, Peru, genital plate, cleared. 13. Dorsal view. 14. Ventral view.

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CONTRIBUTIONS TOWARDS THE KNOWLEDGE OF THE MIGRATION OF BUTTERFLIES¹

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ACKNOWLEDGMENTS

The observations described below are part of a research program in field physiology initiated by Dr. Laurence Irving, to whom we are very much indebted for this opportunity to carry out the work.

As southern Florida is one of the best places to study the migration of butterflies, we were fortunate in being able to use the Archbold Biological Station as a base. Our best thanks are due to Mr. Richard Archbold, director of the station, who placed the excellent facilities of this institute at our disposal, and to Mr. Leonard J. Brass, botanist, and Mr. Frank Rinald for their kind interest and help.

As we are not familiar with the systematics of Lepidoptera we are most grateful to Dr. Alexander B. Klots, who very kindly checked our collections of butterflies. We are also indebted to Dr. B. P. Uvarov for criticisms and suggestions.

So many people in southern Florida assisted us with valuable information that it is not possible here to express our thanks as we should like to do. In the following parts of the paper we shall, however, have opportunity to mention a few, as their information is included among our own observations.

INTRODUCTION

Man's knowledge concerning the ability of insects to migrate, often in large numbers and over considerable distances, dates back

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FIG. 1. Newly hatched *Ascia monuste*.

to prehistoric time. Ever since man has been dependent upon crops in such parts of the world that are exposed to the devastating migrations of locusts, he must have had some knowledge of the phenomenon, but not until the last few decades have we had any real understanding of this strange habit, even for locusts.

As for butterflies, there exists a great miscellany of observations on mass movements and unidirectional flights, and thanks especially to the never-tiring efforts of C. B. Williams all these data have been gathered together. Very few systematic observations and experiments have been made, however, to try to determine the factors governing the travels of butterflies.

From Williams (1942, pp. 142 ff.) we learned that Mr. and Mrs. Karl Hodges of Indiatlantic-by-the-Sea, near Melbourne on the

east coast of Florida, had for several years observed regularly occurring migrations of *Ascia monuste* Linnaeus, the southern white, along the coast, and we decided to concentrate on this species. Unfortunately we soon learned that very little was known about its general habits, so we had, therefore, to begin by acquiring as much data as possible on its general life history.

GEOGRAPHICAL DISTRIBUTION OF *ASCIA MONUSTE* IN FLORIDA

The initial step was to find the animals and especially their breeding areas. Holland (1947, pp. 277-279) indicates that the species occurs in several varietal forms over a vast area covering tropical and subtropical America and that it is "not uncommon in the Gulf States."

During February and March, 1949, traveling by automobile, we tried to cover as much as possible of the area in Florida south of a line from Jacksonville through Gainesville to Tampa. We found none of these butterflies in the northern part of the area, so we did not extend it farther north. In the northern part, especially west of the St. Johns River, *Ascia monuste* seemed to be substituted by *Pieris rapae*.

It may seem that motoring through the country is a rather crude method of getting information, but certain facts justified the method. First, it was the only possible way to cover the considerable area in question in the short time we had at our disposal; second, the inland populations of these butterflies are found mostly at localities close to roads; and, finally, the animals are conspicuous and easily recognized even at some distance. Closer examination was of course made whenever suitable localities were spotted and also whenever animals were seen.

The picture of the distribution we now have is as follows: the animals were abundant in a string of localities along the east coast from Key West in the south to the environs of Titusville in the north, and along the west coast from Key West northward to the Bradenton area. Inland we found several populations at scattered points: (1), northeast of Homestead; (2) at Bare Beach between Clewiston and Belle Glade; (3), just west of Clewiston; (4), south and west of Moore Haven; (5), at Fort Denaud, west of Labelle; (6), west of Brighton; (7), west of Lake Placid; (8), on Hen Scratch Road, north of Lake Placid; and (9), in Sebring.

Eventually we learned that all these localities were breeding areas and, with the exception of nos. 7 and 9, that the food plant



FIG. 2. Breeding area on Hen Scratch Road.

for the larvae was the wild peppergrass, *Lepidium virginicum*. It is well known that the pieride butterflies breed especially on cruciferous plants, and we spent a great deal of time examining cabbage fields in the hope of finding breeding areas. We succeeded only once, in locality no. 7, and even here we saw only a single butterfly and found but three nearly full grown larvae which were hatched in the laboratory to normal *Ascia monuste*.

In Sebring we found populations on nasturtium (*Tropaeolum*) in gardens during April and May; later in the year we found them on *Cleome ciliata*, a plant of the family Capparidaceae related to *Crucifera* recently introduced in Florida. *Cleome* was found on two vacant lots between gardens in Sebring.

As we learned that every time we found a number of individuals inland flying around within a limited area it meant that there was a breeding ground, it puzzled us that we were unable to find where the much larger populations along the coast were breeding. It is true that on one occasion we found a very small population on peppergrass near the beach at Cape Canaveral, but as this plant is not common in the coastal regions, it seemed doubtful that it could be the normal breeding plant. We soon realized that the distribution along the coast coincides rather well with the occurrence of mangrove, but it was not until the latter part of May that we were able to find the breeding plant. It was then found to be the saltwort, *Batis maritima* Linnaeus, which covers vast areas in

the mangrove and the salt marshes. This was first noted on the Fort Pierce Beach, about which further information is given below, and later in the year we found a population on saltwort at Gomez near Bradenton Beach.

Finally, in June and July, we found a small population at Jensen Beach where the larvae were feeding partly on a few specimens of *Lepidium* and partly on *Cakile maritima*.

Although it seems that *monuste* breeds the year round in southern Florida, the different populations seem to last only for short periods. The end of such populations may occur in different ways. The colony on Hen Scratch Road was exterminated by a chalcidian wasp (?*Pteromalus puparum*). Sometimes the food plant will disappear—*Lepidium* often dries up in late spring, and during the summer it becomes rather rare. Or man may interfere with the populations by destroying the food plants—cutting grass and *Lepidium* along the roadsides or by spraying insecticides. None of these causes for the end of breeding, however, can account for the extermination of the colonies in the mangrove; we shall refer to this point later.

LIFE HISTORY OF *ASCIA MONUSTE*

EGGS

The egg has about the same shape as a dirigible and is 1.1 to 1.3 mm. long and about 0.56 mm. in diameter at the broadest part, which is a little below the middle. The eggshell has at the top a figure very much like the stigma on a fruit, with eight to 10 lobes, from which ribs run longitudinally to the base of the egg. Generally there are a few more ribs than lobes, these ribs starting a little below the "stigma." Between the ribs the surface is very finely wrinkled.

The color is usually whitish yellow, but we have also seen greenish eggs that gave normal individuals. After approximately three to five days, depending on the temperature, the eyes of the larva can be seen through the eggshell, and on the following day the hairs, as well as the mandibles gnawing at the shell, can be seen.

The eggs are deposited upright on the leaves of the food plant. There are some differences in the way the eggs are deposited in the different populations, presumably according to the food plant. Of the peppergrass the butterflies prefer young plants without



FIG. 3. Egg on *Lepidium*.

flowers 10 to 15 cm. high. The plant is so tiny that the weight of the butterfly will bend it down. During the egg laying the butterfly will generally hold its head erect, the abdomen is directed towards one of the leaves and touches it for a moment. A few seconds later the butterfly flutters away low over or through the vegetation to find a new plant while the top of the first plant springs up to normal position with the egg on the leaf. One can easily understand why, with this procedure, the eggs are generally found on one of the upper leaves of the plant, and mostly on the upper surfaces. On *Lepidium* the eggs are deposited singly, and only in comparatively few instances were two on the same leaf; we once found three, but their main axes differed which might indicate that they had been laid at different visits, probably by different females.

On *Batis* the eggs are deposited as on *Lepidium*, and, though our knowledge is rather limited here, the same seems to be true with *Cakile*. On *Tropaeolum* and *Cleome*, however, the eggs are laid in clusters in which the number of eggs may be as high as 50. During such an egg laying the female curves the abdomen towards the surface of the leaf for a couple of seconds, then stretches it out between the wings for about 10 seconds, and then recurves it to lay another egg, and so on. Towards the end of such a deposit there may be fairly long intervals between the egg laying, until finally the animal flies away, generally to feed on some flowers.

The total number of eggs laid by a female is so far unknown, but we have had in captivity a female that produced 115 eggs in one day. We have reason to believe that a female in its lifetime is capable of laying eggs for a period of from three to six days, and the total therefore would probably be between 200 and 1000.

LARVAE

The newly hatched larva is about 2 mm. long and must pass through at least four molts before it reaches the final length of about 35 mm. In nature the duration of the larval stage is about three weeks.

The full-grown larva looks very much like the larva of a common cabbage butterfly; the body is brownish green, with a yellowish stripe on each side and three greenish stripes on the back. Between the stripes each segment has four large black spots (the two on the back placed a little more cranial than the lateral ones) and several smaller spots. On the prothorax the black spots are



FIG 4 Egg cluster and hatching larvae on a *Tropaeolum* leaf.

larger and cover most of the segment. There are, as usual, abdominal legs on the third to the sixth abdominal segments and a pair of claspers on the last. In the first instar the larva is more yellow and has fewer dark spots

All the larvae of the egg clusters on *Cleome* and nasturtium are hatched within a few hours, and such larvae have a strong tendency to stay together. During the first two ecdyses they are very often seen in a common carpet of web, the bodies in the same direction, looking like fingers on a hand. Later they are more solitary in their habits, and when they are ready to find a place to pupate they always spread out and seem rather to avoid one another.

From the time a full-grown larva stops eating until the transformation to pupa takes place is often a couple of days. First they move about for some time seeking a suitable place. This is much easier for the animals that use the broad leaves of *Tropaeolum* on which to pupate (and the same may be true of cabbage). Caterpillars from the other food plants must find a place in the neighborhood, although in one case at Bradenton Beach



FIG. 5. Two young larvae on *Batis maritima*.



FIG 6. Full-grown larva

we found a pupa on *Batis*. At Fort Pierce Beach we saw a pupa on a leaf of the white mangrove, *Laguncularia racemosa*; close to the population on *Cakile* we found the pupa on the leaves of *Coccolobis uvifera*. The larvae from colonies on peppergrass generally use the stems of plants growing around them such as *Eupatorium* or *Ambrosia*. From *Cleome* we have seen them pupate on the south, exposed wall of a shed some 5 to 10 feet from the food plants.

PUPAE

When the larva has found a suitable place it spins the two webs that support the pupa. First, with the head downward, it spins a little band about the shape of the vamp of a shoe, then it turns around and places its claspers and the last segment of the abdomen in the "shoe," which soon hardens and glues the hind tip of the body to the support. By moving the head from one side to another, the caterpillar can now spin the thread that supports the



FIG 7. Larva with silk thread.

body just below the thorax. In the following hours the animal will gradually become shorter and thicker, and the hump-like



FIG 8 Pupa on *Ambrosia* stem.

form of the thorax will be progressively more discernible. In nature the imago will normally appear within six to eight days after the larval skin has been shed.



FIG. 9. Left: Totally green pupa on *Tropaeolum* stem. Right: Black and white pupa on *Ambrosia* stem.

The color of the pupa is very variable and seems to some degree to be dependent upon the color of its surroundings. The green pupae from *Tropaeolum* are markedly illustrative of this, especially as compared with the gray, white, and black pupae from the dry stems of *Eupatorium*.

IMAGINES

Observations during the mass outbreak at Fort Pierce Beach in May seemed to show that the females are hatched a little earlier than the males. Breeding experiments in the laboratory, however, have not given any confirmation of this.

The animals feed on all available flowering plants. We were not able to find a preference for any particular kind, with the exception perhaps of *Bidens*. But *Bidens* is, of course, one of the most abundant plants available all the year round in Florida, and it is moreover the favorite plant of butterflies and many other insects.

In the laboratory it is possible to keep the butterflies alive for some time by feeding them sugar water; the males live for four to eight days, the females twice as long. Observations in the field suggest a similar short life span; there is probably a pre-oviposition period.

Until about the middle of April all the individuals we found were white save for the typical black markings on the wings; after that date, all the females were more or less dark colored, indicating the variety *phileta*, though the coastal form seemed to have darker females than the ones from the inland population.

MIGRATIONS OF *ASCIA MONUSTE* IN THE SPRING OF 1949

DEFINITION OF TERRITORY

We became especially aware of how limited the normal flying range of *Ascia monuste* is during our almost daily observations of the population on Hen Scratch Road, north of Lake Placid.

The actual breeding area was approximately 20 by 16 meters, situated between the road and the border of Lake Stearns, partly shadowed by eucalyptus and other large trees. Flying low over this area were usually about half a dozen butterflies, females with the short-turned, whirling flight so typical in egg laying, and males flying after them. Other individuals could be found in the vicinity seeking food on *Bidens* beside the road or on flowers in the scrub. Sometimes the circling around one another, which is an introduction to the mating, would carry a couple up to the tops of the trees.

A first glance of the colony may give the impression of a continuous going and coming of butterflies, but closer observation will prove this to be erroneous. The animals leave the breeding area for only short flights in the immediate neighborhood. As a matter of fact, we saw none more than 100 yards from the place where in all likelihood they had been raised.

This concept, that the butterflies are normally limited to a certain territory, was confirmed by observation at other breeding localities. Some of these localities were much larger and con-

tained many more individuals, and were therefore somewhat more complicated, but in each instance a close examination showed that the habitat consisted of a nucleus, with plants for breeding, surrounded by an area outside which the inhabitants did not go but inside which they flew around more or less casually.

FIRST RECORDS OF MIGRATION

On March 13, along the road at Craig on the Florida Keys, we noticed some whites flying, but only one or two at a time. Here, where the road is a sort of causeway, we observed several single individuals flying northward. They traveled so fast that we had difficulty in catching them. The flight was not only faster than normal but also more determined. There were but few flowers along the roadside, and it seemed remarkable that the butterflies seemed to ignore them.

One mile north of the Caloosahatchee River at Olga, where State Road 31 turns westward, a white butterfly was observed on March 20, crossing the road flying east-northeast. The vegetation here, as far as can be seen in all directions, is open flatwood pine forest without any flowering plants. In the ditches beside the road, however, *Bidens* and other flowers were present, but the butterfly crossed the road just over the flowers, ostensibly without paying attention to them, and continued its flight, which was in a remarkably straight line as far as it could be followed by the eye. We stayed at the place for more than half an hour but saw no more butterflies.

Just north of Okeechobee (1.5 miles north of the junction of State Roads 19 and 70) three or four white butterflies were seen on April 15 at 8:57 A.M. crossing the road at brief intervals, steadily flying towards 210° magnetic bearing.

The same day, between 9:25 and 9:55 A.M. (Eastern Standard Time), a stream of *Ascia monuste* was seen crossing State Road 68, 3.8 miles east of State Road 19, flying towards 210° magnetic bearing. The country is open here, and it is possible to watch the animals over a considerable distance. They appeared at the rate of one or two per minute, and the distance between them was so great that it is highly improbable they could see one another. Nevertheless they crossed the road within 100 yards or so of the same spot.

It seems justifiable to assume that the individuals seen north of Okeechobee were other individuals of the same stream, the tracks

coinciding perfectly. If the track had been extended southward over Lake Okeechobee it would have met the south coast in the neighborhood of Moore Haven. The populations at Moore Haven were first seen in the middle of February but disappeared during March. A week after the stream at Okeechobee was observed we passed through the Moore Haven area and again observed numerous whites, but we have, of course, no evidence of the origin of these animals.

If the track were retraced backward it would cross the east coast between Wabasso and Melbourne. Although in the afternoon we found numerous whites along United States Highway 1, especially between Sebastian and Roseland, no migratory movements were observed.

If it be assumed that the two streams observed April 15 north of Okeechobee are identical, these observations lead to an interesting conclusion: The two observation points are about 15 miles apart. We were not able to measure the ground speed of the animals, but we estimated it to be about 8 miles per hour. As the flight cannot have started before about 8:00 A.M. (Eastern Standard Time) on account of the temperature (see below) the individuals seen at Okeechobee before 9:00 A.M. must have started from a point between our observation points. This seems to indicate that this stream had started the preceding day, stopped during the night, and had resumed flight again in the morning.

DEFINITION OF MIGRATION

The observations described above were of the behavior of butterflies outside their territory. We had no doubt that we were watching migrations, although on a very small scale. Later observations in the Fort Pierce area gave us a much clearer picture of migration, but before describing them it might be of value to define the term "migration" as used in this paper. A more thorough discussion of the phenomenon will be postponed to a later communication.

We use the term "migration" to describe a more or less unidirectional active movement of an insect outside its normal territory.

We are aware that in the field of vertebrate animals the term "migration" indicates a movement that includes a return of the animal to its original territory. We are furthermore aware that C. B. Williams, who has collected all available data indicating return flights in butterflies, is gradually becoming convinced that

return flights are characteristic not only of a few species but of a majority of the migrating species as well. This may be true, but we cannot consider it an established fact for any of the migratory species. It would therefore be more accurate to use such a term as "exodus" for the phenomenon in question, but the term "migration" is so commonly used that it seems inadvisable to change it. For insects the term should be used with the reservation that it does not include any indication of a return flight.

The whole problem of nomenclature for these movements seems to us of minor importance. When we acquire some insight into the physiological mechanisms of the movements a rational nomenclature must be established; on this point, however, we have as yet no knowledge for either vertebrates or insects.

OBSERVATIONS IN THE FORT PIERCE AREA

Mr. Brass first drew our attention to the Fort Pierce area. We visited the beach here for the first time April 2, and found a number of *monuste* flying around in spite of cool and windy weather. The same was true at Jensen Beach, especially on the west side of the island where there is mangrove.

On April 11, we found no butterflies here, but as we followed the road on the island south of the Fishing Lodge we found a number flying around just south of the old Coast Guard Station. It was here that, later in June, we found the butterflies breeding on *Cakile*. We also tried to follow the road north but that section had been destroyed by a hurricane some years ago, and the country was so difficult to travel, even in our "jeep," that we gave it up. We saw no butterflies there. On State Road 707 we observed three butterflies flying steadily south-southeast along the road, apparently migrating. At the south beach at Fort Pierce there were more butterflies, one or two traveling rapidly and unidirectionally south.

When we returned to Fort Pierce April 11, Mrs. Boone, proprietor of a gasoline station, suggested that we visit the north beach, because there at certain times of the year so many white butterflies appeared that "all the bushes looked like fruit trees in bloom."

As the following days were cool and windy, we did not return to Fort Pierce until April 15 (the morning of the same day we made the observation at Okeechobee referred to above). On the islands, especially on the north beach, on the bridges, and on the

mainland close to the bridges, enormous numbers of white butterflies were observed. They were not migrating but only flickering around and feeding on all sorts of flowering plants and bushes which they covered so thickly that they looked like cherry trees in blossom. Of 23 individuals caught, only three were females: one with small eggs, two with large eggs, in the ovary.

A female caught *in copula* had small eggs in the ovary. All the females were of a dark color (variety *phileta*). We observed no egg laying, nor did we find any eggs, larvae, or pupae. We followed the road north-northwest on the island and found that the number of butterflies did not diminish until about 5 miles farther north. Towards Vero Beach they were fewer in number, but at the same time we observed that the individuals were definitely migrating northward. North to Vero Beach, at least two streams were seen: one along the road and another just behind the dunes. On the road the butterflies passed at the rate of 22 individuals each minute. Streams were again found at Melbourne Beach, but the rapidly dropping temperature, which at 3:50 P.M. fell below 25° C., stopped the migration and the animals made interruptions to feed along the road.

The same day Mr. and Mrs. Lord, of the Fishing Lodge south of Jensen Beach, made the following observation: "About 7:30 A.M. unusually many individuals were seen, at 8:00 A.M. enormous numbers streamed in clouds towards the south. A colored man working in the garden had to brush them away to get working space. The stream covered the island six miles up to One Mile Bridge but were not found on the mainland. It lasted until 1:00 P.M. when it gradually stopped. The wind was weak from E or SE."

The next two days, April 16 and 17, were cool and, although a few directional flights were seen, they could hardly be described as migrations, as the animals continuously stopped for food or mating.

On April 18 we again observed migration on the beach north of Vero Beach. The same day Mr. and Mrs. Karl Hodges, of Indiantlantic at Melbourne Beach, reported as follows: "Today the southern whites have been flying along the Beach Highway, and seem to be in mass migration in reality to the north.

"About every minute, many in groups about seven feet from ground, 15 mph (about wind Southeast), warm, partly cloudy during day. Flying from about 11 A.M. to 4 P.M. and possibly longer.

"They are finding a place to settle for the night on the casuarina trees. Many on north side of some of trees as I write this."

On April 23 migrations were observed towards the south between Palm Beach and Stuart. North of Stuart they followed the beach but farther south they seemed mostly to follow United States Highway 1.

The intensity of the stream was rather low, about eight per minute. Fort Pierce Beach was inspected April 15, 16, 17, 18, 19, 23, 24, and 29. During these two weeks the number gradually diminished, so that on the last date the population was normal. There seemed to be nearly the same number of males and females.

From April 24 to 29 we inspected the area from Titusville to Stuart and found no real migrations in spite of favorable weather. Observers at Titusville Beach and at Cape Canaveral had not yet noticed any remarkable migrations.

In the first part of May only very few individuals were found at any place between New Smyrna and Miami. On May 10 a new outbreak started, and in the following week the number of individuals at Fort Pierce north beach rose enormously while it remained at the same low level at all other places between Vero Beach and Miami. The first day there were many more females than males; later, the reverse. On May 17 there were clouds of them at Fort Pierce, and the same day the migrations started in both directions along the shore. During the following days the streams increased in intensity until on May 20 streams up to 28 individuals per minute were observed. At the south beach the streams flew southward, and only 5 miles to the north they were headed in the opposite direction. On the neighboring part of the mainland were many butterflies, but we saw no definite migration.

GENERAL CONCLUSIONS OF THE OBSERVATIONS AT FORT PIERCE

It seems to us that the most striking feature of the habits of the butterflies at Fort Pierce Beach is that the hatchings of the imagines occur within a few days, over an area which is not so very large considering the enormous production of imagines but considerably larger than the inland colonies. In these we always found that the production of new individuals went on continuously; we always found eggs, larvae of all sizes, pupae, and imagines at the same time, and the number of adult butterflies remained about the same for long periods. At Fort Pierce we

had a very distinct maximum on April 15, and after the observation of the hatching time in the laboratory we could expect the next generation to come between 33 and 41 days later; the maximum of the next outbreak was May 20, 36 days after the first.

From these observations we conclude that the first requirement for a migration is a mass outbreak—a simultaneous hatching of a whole population within a few days. It may be asked if this is not a fiction. One might think that migrations also take place from smaller populations but escape notice because the individuals are few. This objection, however, does not fit in with our observations. From May 7, when we saw only three or four butterflies through the whole area at Fort Pierce, until the migrations started May 17, we made observations in the area every day except May 8, 14, and 15. Although we were looking especially for migrating butterflies we saw none. As soon as we had seen the migrations start, we traveled as far as Miami and returned slowly to meet the southgoing migration. This happened in the afternoon of the next day at Fort Lauderdale Beach where, in about half an hour, we saw six *monuste* flying south. The distance from Fort Pierce to Fort Lauderdale, following the coast, is about 100 miles, and as there can hardly be any migratory flights between 5:00 to 6:00 P.M. and 8:00 to 9:00 A.M. it may be assumed that these animals had left Fort Pierce early the preceding day when we saw the first migration heading north. The following day we found the southward migratory flights as soon as we reached Jupiter Beach and the northward flights at Vero Beach, both fully developed.

These observations have removed for us any doubt of the relationship between mass outbreak and migration. This relationship in itself of course provides no solution to the main problem: how and why the migratory reflex apparatus is activated. But it divides it in two: (1), how can the crowded conditions present at a mass outbreak activate migration, a problem that has a remarkable similarity to the problem of the effect of crowding on the development of the migratory phase in locusts; (2), why do certain populations develop mass outbreaks, or rather why do some populations have a continuous production of new individuals and why do other populations breed in waves.

Obviously, the first step in approaching this problem would be to examine the breeding areas of the population, but as already mentioned above we did not succeed in finding the breeding

grounds until May 17, the same day the second mass outbreak led to the first migration. We observed on that day, and repeatedly during the following couple of weeks, a great many acts of egg laying and found many eggs on *Batis* in the mangrove, but only once did we find two small larvae. Even when we carefully marked the egg-bearing plants and the position of the eggs, we were never able to find the larvae. The leaves showed no signs of having been bitten, nor were any droppings found. Generally we could not find even the eggshell. The newly hatched larva generally eats in captivity at least part of the eggshell, but in most cases some is left, especially of the base.

The number of adults diminished gradually and did not rise to a new outbreak in June, although single individuals were still seen during the last part of July. Nevertheless, upon removal to the laboratory the eggs from *Batis* developed normally and the larvae were easily reared on *Batis*, *Lepidium*, or *Tropaeolum*.

As we have as yet no evidence for what happened to the eggs in nature we shall make no suggestions towards an explanation but will mention only that the phenomenon was not unexpected. From previous reports on migrations of *Ascia monuste* we knew that they are limited to the season between March and June.

REMARKS ON THE MIGRATORY FLIGHT

Of course it is not possible for us at the present stage of our investigation to approach the main problems of the migrations of insects generally, nor even of the species we are studying, but nevertheless we believe that some concluding remarks might be useful.

We have defined migration as a unidirectional active movement of an insect outside its territory. In addition to this theoretical definition, we wish to draw attention to some characteristic elements in the behavior and especially to those that enable the observer to decide whether or not a butterfly is migrating.

THE UNIDIRECTIONAL FLIGHT

The flight of a butterfly is always more or less flickering, but the observer will have no real difficulty in recognizing a flight as unidirectional. The migrations of *Ascia monuste* take place rather low, in heights of 3 to 10 feet above the ground, so that a person situated in the direction of flight can easily see that the flickerings are only oscillations along a certain direction. In a

flight of this kind, the best means of determining the direction is by the use of a field glass attached to a liquid-filled compass. With such a sight-vane placed at a point in the track it is possible to follow the animal and estimate the direction of flight within a few degrees.

Gunn and others in a recent publication (1948), in describing the flight direction of migratory insects, called attention to a very important point. They show the necessity of describing the direction and speed in relation not only to the ground but also to the surrounding air masses. They have proposed, therefore, the use of the same terms that are used in aircraft navigation:

TRACK: The direction in relation to the ground

GROUND SPEED: The corresponding speed

COURSE: The direction in which the animal is heading

AIR SPEED: The speed in relation to the air

DIRECTION: For the flight of the animal, the magnetic bearing (0° – 360° mag.) towards which the animals are heading, or flying

WIND DIRECTION: The magnetic bearing from which the wind comes

WIND SPEED: Given, as with the other speeds, in miles per hour (mph)

It will be seen that the three velocities mentioned above can be considered as the three sides in a triangle, with the differences between the directions as angles. If we know two of the sides (e.g., ground speed and wind speed) and an angle (difference between track and wind direction) it is possible to construct the triangle and find the third side, i.e., the air speed and the course. (See fig. 10.)

The air speed, x , can also be calculated by means of the expression

$$x = \sqrt{(A \pm \sqrt{v^2 - d^2})^2 + d^2}$$

where A is the ground speed, v the wind speed, and d is equal to $v \sin c$, c being the difference in angle between track and wind direction. The plus sign must be used for $0^\circ < c < 90^\circ$ and $270^\circ < c < 360^\circ$, and the minus sign is valid when $90^\circ < c < 270^\circ$.

If b is the difference in angle between track and course, we have

$$\sin b = \frac{d}{x}$$

For values of c between 0° and 180° the course, s , is

$$s = t + b$$

and for $180^\circ < c < 360^\circ$, we have

$$s = t - b$$

■ Thanks to a suggestion in the paper by Gunn and others we have during our observations developed a method which allows

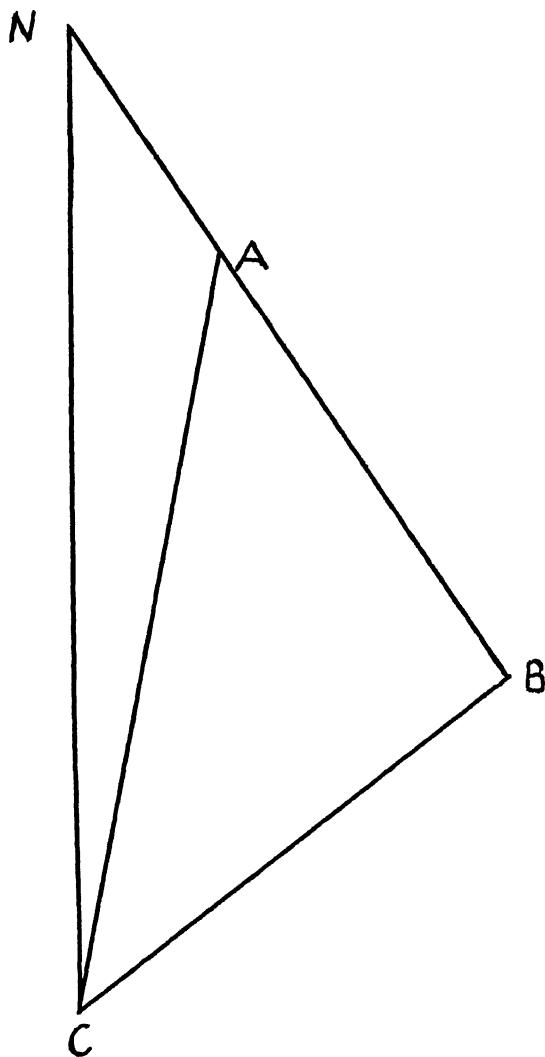


FIG. 10. Diagram to determine air speed and course. CN, degrees, magnetic bearing; angle NCA, track, degrees, magnetic bearing; angle NCB, wind direction, degrees, magnetic bearing plus 180° . If CA and CB are proportional to the speeds of the butterfly and the wind, respectively, then BA will indicate the air speed, and angle CNB plus 180° will be equal to the course.

us under certain conditions to measure the air speed directly and so check on the reliability of the measurement. So far we have made only three measurements of this kind. It is necessary to find a place where the track of the stream of butterflies passes over uniform and even ground (preferably along a road) for a distance of $1/2$ to 1 mile. In the middle of the distance the windial anemometer is put up. In that end of the track from which the butterflies are coming, the car, with the cup anemometer attached to the windshield, starts at the same time as one of the migrating individuals and follows it over the distance. The distance is measured by means of the speedometer of the car, and the time is taken by a stop watch. Simultaneously the wind direction and wind speed are measured with suitable intervals on the windial. The magnetic bearings of the position of the windial and of the track are found by means of the sight-vane described above. The ground speed is the distance divided by the time in seconds multiplied by 3600. To reckon the air speed, the number of contacts of the cup anemometer is divided by the number of seconds and multiplied by 60. A direct observation of the course (the direction of the head of the butterfly) seems to be impossible to obtain.

By this method we made three determinations of the course and air speed, and later we checked the method by driving with constant speed, making the same observations as if the car were following a butterfly. This check was made on the road between Childs and Arcadia (State Road 70) where the country is open in all directions and the road runs on a straight 90° to 270° magnetic bearing for several miles. The results are given in table 1.

The expression "unidirectional flight" needs further explanation. As stated above, the flight is generally so straight, for as long as the eye can follow the animal, that a determination of the track can easily be made. On the other hand we have on several occasions seen the track change a little to conform to topography.

The numerous observations by Mr. and Mrs. Karl Hodges indicate that the direction of flights is always towards the south or north. In Florida most roads are orientated towards the four cardinal points except those along the coast which strike along or run at right angles to it. At Melbourne the coast and the roads vary about 20° , so that what are generally called north and south are really north-northwest and south-southeast. The essential point is, however, that all descriptions of previous authors—Ball

TABLE 1

Locality and Date	Track (degrees mag. b.)	Ground Speed			Wind		Air Speed				Course (de- grees mag. b.)
		Dis- tance (miles)	Time (sec- onds)	Speed (mph)	Average direction (degrees mag. b.)	Average speed (mph)	Con- tacts	Time (sec- onds)	Speed Ob- served (mph)	Speed Calcu- lated (mph)	
State Road 70; 7/30/49	90	1.4	373	13.5	298	3.7	60	373	9.6	10.4	80
State Road 70; 7/30/49	270	1.0	257	14.0	318	3.0	76	257	17.7	16.2	278
State Road 70; 7/30/49	90	1.0	410	8.8	322	2.8	46	410	6.7	7.4	73
State Road 70; 7/30/49	270	1.0	432	8.3	328	4.4	93	432	13.0	11.3	289
Vero Beach; 4/18/49	0	.5	180	10.0	189	2.9	22	180	7.3	7.6	356
Jupiter; 4/23/49	180	.4	200	7.2	120	7.2	42	200	12.0	12.4	150
Jensen Beach; 5/19/49	160	.7	317	8.0	90	6.0	44	317	8.3	8.2	116

and Stone (1928), Fernald (1936, 1937a, 1937b), Stirling (1923), the Hodges as cited by Williams, *et al.* (1942), as well as ourselves (except for our observations at Okeechobee), and a few records of mass flights seen over the sea—have dealt with observations of migrations in Florida only along the coast. A closer examination shows that topographical features modify the direction. Individuals following the road on the island will follow it even if it changes direction slightly (5° to 10°). North of Palm Beach the coast line runs from north-northwest to south-southeast, and south of Palm Beach it runs north to south. Our observations indicate that the majority of the butterflies make this turn along the coast line, but there is a possibility that in some instances some continue the south-southeast track out over the sea.

We saw several individuals flying over Indian River (not migrating but flickering around), but we never saw a butterfly leave the coast and fly out over the ocean. Only in exceptional cases do they approach the ocean beyond the dunes.

RANGE OF MIGRATORY FLIGHTS

Our remarks on this are somewhat limited because we had no means of marking individuals, but assuming that all the migrations along the coast from April 15 to 20 and May 20 to 28 originated in the Fort Pierce area, which is probable, we are able to give some data.

During the migrations the northernmost point at which we found animals flying north was at Titusville Beach. The distance along the coast from Fort Pierce Beach to Titusville Beach is about 85 miles (135 kilometers); the southernmost point at which we found animals flying south was, as previously mentioned, at Fort Lauderdale which is a distance of about 100 miles (160 kilometers) from Fort Pierce.

At these end points the streams were very weak, with few individuals, and our observations showed that the streams gradually became weaker as they approached these points.

Although we must again stress the fact that we have no positive data concerning the range of migratory flights, we find it very probable that the range extends to approximately 100 miles in each direction, which represents about 12 hours of flight. This means that the migration lasts from one to two days of the five to six days (males) or 10 to 12 days (females) that constitute the normal life span of *monuste*.

THE MIGRATION AS MASS MOVEMENT

It will be seen that the main characteristic of the migration is the unidirectional flight of the single individual. Generally, however, continued observations show that a number of individuals follow the same track. The migration therefore takes the form of streams varying in width from 10 to 100 yards. The intensity of a stream may be defined as the number of individuals per mile of the stream (S), and it can be estimated by counting the number of individuals (s) passing a cross section of the stream per minute and measuring the speed in relation to the ground (G). The intensity is then

$$S = 60 \frac{s}{G}$$

As we have found that G is rather constant in all our observations (in one case, 7.3; another, 10.0; five others, between 8.0 and 8.5 mph) no large error will be made in using s instead of S , as in many cases it will be difficult to determine the ground speed. We have found s to range from .2 individuals per minute to 30 individuals per minute.

Sometimes the animals appear singly, sometimes in small groups of two to five individuals separated by intervals. But in any case they behave quite independently of one another. It is especially instructive to observe a very weak stream, the individuals coming at such long intervals that it must be presumed they cannot see one another; nevertheless they behave very much in the same way.

As here described the migrations take place as narrow streams, but very often there is more than one stream going in the same direction, a few hundred yards apart. On the islands between Indian River and the ocean, where we made most of our observations, there were generally three streams, one along the dunes, one along the road, and one through the higher vegetation along the river. Generally the last one is not so sharply defined as the two others but is more diffuse.

REFLEX PATTERN OF MIGRATION

This is a part of the study of migratory habits which so far has been very much neglected, and we are not able to contribute to it beyond calling attention to certain facts that seem to have escaped the notice of previous authors.

For the butterflies living in a territory there seem to be four principal reflex patterns for the female and three for the males:

FOOD INTAKE: Common for both sexes

MATING REFLEXES: Different for males and females

EGG LAYING: Of course limited to the females

RESTING: During night and in cool weather, and basking in the sun, and cleaning, the same for both sexes

A further analysis of the behavior must await a later publication. For the present we wish only to point out that a butterfly in its territory always shows a behavior that can be referred to one of these four patterns. All flying around in the territory seems to be only "appetite behavior," in the sense of Lorenz, as introduction to one of the first three principal reflex patterns.

During the unidirectional flights outside the territory the butterflies seem not to have any of the normal principal reflexes. They do not stop to feed. Males and females travel side by side without taking apparent notice of each other. The flight is not an introduction to anything; it is a goal in itself. During migration the animals do not fly in search of a stimulus that may release a reflex; the flight is an independent reflex action. We still need to discover the physiological conditions for the corresponding "mood" (Stimmung) and the stimulus that releases it.

THE INFLUENCE OF PHYSICAL FACTORS ON MIGRATION

The following remarks are to be considered as only preliminary; our observations are too few and not detailed enough to permit elaborate conclusions.

Temperature is of major importance to migrations. We never saw fully developed migrations below 27° C. air temperature. In the morning the animals fly around and feed on flowers until the temperature of the air has risen to about 24° to 25° C. At that temperature some animals start to fly unidirectionally, but they may often stop to feed. As the temperature rises, the visits to the flowers become scarcer, and when the air is above 27° C. the migratory flight becomes typical in form. We also saw that dropping temperatures stop the migration at the same levels.

Our measurements have been too few to enable us to establish a relation between air temperature and the air speed of the flight. We have as yet made no measurements of the body temperature.

The migratory flight seems to be highly independent of the wind. We saw butterflies flying low and obviously taking advan-

tage of sheltering vegetation at wind speeds of 12 miles per hour across the flight, when this could be done without changing the general direction of flight. The direction of flight is determined more by topographical features than by the wind. As our few observations show more variation in the air speed than in the ground speed, it is probable that speed is regulated by visual stimuli as well.

Slight rainfall has no effect on the migration if the temperature does not go below 26° C. We made one observation during a heavy shower that stopped the migration (Jensen Beach, May 19) for a while. As soon as the sun reappeared the butterflies left the still dripping shrubbery where they had stayed and at once resumed the migration.

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NOTES ON SOME ASIATIC NUTHATCHES AND CREEPERS¹

BY CHARLES VAURIE

INTRODUCTION

This paper is a report on the nuthatches and creepers collected by Dr. Koelz in Iran, Afghanistan, and India. It includes specimens from a new region of India, the Khasia Hills, not covered by the first four papers in this subseries. This new collection has been received recently from Dr. Koelz.

In the list of specimens the term immature (imm.) indicates specimens in juvenal plumage, and the term subadult (subad.) specimens in first winter plumage, or juvenal specimens in which the moult into first winter plumage is far advanced.

Dr. Ernst Mayr has, as usual, given me the benefit of his friendly guidance, and I have also received suggestions and help from Messrs. Jean Delacour and Dean Amadon. I thank them with much pleasure.

SITTIDAE

SUBFAMILY SITTINAE

I am placing the true nuthatches and the Wall Creeper (*Tichodroma*) in the same family (Sittidae), dividing it into the subfamilies Sittinae and Tichodromadinae. The latter is usually included in the family Certhiidae, but *Tichodroma* in the appearance and texture of its entire plumage including the shape and pattern of its tail appears to be closer to the nuthatches than it is to the true creepers. In habits also it is close to the rock nut-

¹ Notes from the Walter Koelz Collections, Number 6. The previous papers in this subseries are: 1949, American Museum Novitates, nos. 1406, 1424, 1425; 1950, *ibid.*, no. 1459; 1950, Jour. Bombay Nat. Hist. Soc., vol. 49.

hatches. As Hellmayr states (1911, *in* Wytsman, *Genera avium*, pt. 16, p. 2), it is difficult to draw a line between the Sittidae and Certhiidae, *Tichodroma* being decidedly intermediate. Hellmayr places *Tichodroma* in the Certhiidae; however, externally at any rate, about the only thing it has in common with the latter is the shape of the bill, a character which seems to be purely adaptive.

Sitta europaea rubiginosa Tschusi and Zarudny

IRAN: Mazenderan (region of Gurgan): Gozlu, July 15-16, 1940, 1 subad. ♂, 2 subad. ♀; Dimalu, July 22-23, 1 ad. ♂, 3 subad. ♂, 2 subad. ♀; Kherat, July 25, 1 subad. ♂, September 30-October 1, 2 ad. ♂, 1 ad. ♀. Khorasan: Kotaliyekchinar, August 3-4, 1 ad. ♂, 1 unsexed subad.

Sitta europaea persica Witherby

IRAN: Luristan: Kalvar, May 27-28, 1940, 2 imm. ♂, 1 imm. ♀; Durud, October 21, 1941, 1 subad. ♂. Bakhtiari: Pashmshurun, April 30-May 9, 1940, 3 imm. ♂, 2 imm. ♀; Damavar, May 3-6, 3 ad. ♂, 1 imm. ♂, 1 ad. ♀; Belu, May 8, 1 ad. ♂; Baraftab, January 30, 1941, 1 ad. ♀; Ti, February 2-12, 4 ad. ♂, 2 subad. ♂, 3 subad. ♀, 1 unsexed ad., June 6, 1940, 1 ad. ♂; Imarat, February 14-20, 1941, 6 ad. ♂, 1 ad. ♀? [♂], 3 ad. ♀. Fars: Dastarjin, April 9, 1940, 3 ad. ♂, 1 ad. ♀.

The differences between the two Iranian populations are well marked: the population (*rubiginosa*) from northern Iran (Gurgan and Khorasan) is larger, with longer wing and bill, the bill being considerably thicker, more massive, and the plumage above and below very distinctly darker than in the population (*persica*) from the Zagros and Fars.

As noted by Stresemann (1928, *Jour. Ornith.*, vol. 76, p. 365), the northern population is very similar to the population of *caesia* from central Germany. My specimens of *rubiginosa* differ from a long series of *caesia* from central Europe (Hesse, Switzerland, Austria) almost solely in the shape of the bill which in *rubiginosa* is thicker, less compressed laterally. My specimens from the region of Gurgan (topotypical) and Khorasan fail to show the small color differences cited by Stresemann but, on an average, are slightly paler below and the rust is clearer than in *caesia*.

A series from the Caucasus (*caucasica*) is distinctly darker below than *rubiginosa*, and darker above and much darker below than *persica*. A lone specimen in comparative plumage of *levantina* from Eregli, Asia Minor, is paler above than *rubiginosa*; below, this specimen is like *rubiginosa*, slightly paler than *caucasica*, and distinctly darker than *persica*. In *caesia* and *rubi-*

TABLE 1
GEOGRAPHICAL VARIATION IN SOME RACES OF *Sitta europaea*

Race and Region	N	Wing	Bill	Coloration	Frontal Band and Superciliary Stripe
A <i>caesia</i> central Europe	10 ♂ 9 ♀	85-89 (86.85) 83-88 (85.70)	Long, more compressed laterally and more pointed than B	—	Lacking
B <i>rubiginosa</i> Gurgan, Khorasan	4 ♂ 1 ♀	86-89 (87.50) 89	Long, thicker	Perhaps very slightly darker and duller above; slightly paler below, clearer than A	Of five adults: present in one, faint trace in another
C <i>caucasica</i> Wladikawkas	4 ♂ 2 ♀	86-87 (86.25) 84, 85	Short, thick as in <i>rubiginosa</i>	Darker below than A and B	Present
D <i>levantina</i> Eregli, Asia Minor	1 ♂ 1 ♀	84.5 86	Short, more compressed laterally and more pointed than in <i>caucasica</i>	Above, slightly paler than A, B, and C; below like B	Present
E <i>persica</i> Zagros and Fars	17 ♂ 6 ♀	82-87 (84.50) 79-85 (82.10)	Short, pointed and thinnest	Palest above and below	Present

Individual bill lengths of the specimens in table 1: A, *caesia*: males, 20.5, 21, 21, 21.5, 21.8, 22, 22, 22.3, 22.5, 23; females, 20, 20.5, 21.3, 21.5, 22, 22, 22, 22, 23, 23.5; female, 23.5. C, *caucasica*: males, 20, 20, 20.2, 20.5; females, 18.5, 19.5. D, *levantina*: male, 19.5, female, 21.5, united, 20. E, *persica*: males, 19.5, 19.5, 19.8, 20, 20, 20.2, 20.5, 20.5, 20.5, 21, 21, 21, 21, 21.5; females, 19.5, 20, 20, 20.5, 21.

ginosa the bill is long; it is shorter in *caucasica*, *levantina*, and *persica*, averaging thinnest in the latter.

The geographical variation is best visualized in tabular form (table 1). The white frontal band and superciliary stripe when present is poorly marked at best. The bill is measured from the skull; the individual measurements are given below the table.

MOULT: The moult in *rubiginosa* and *persica* seems to start towards the end of May. Adult specimens from the early part of this month are extremely worn but show no signs of moult, the first moulting adult being a male taken on June 6 at Ti in Bakh-tiari. The moult may be over by early August, for it is just about completed in two specimens taken on August 3-4 in Khorasan. The partial postjuvénal moult takes place at the same time as the complete moult of the adult. When the specimens are not worn, first winter birds can be distinguished from adults by the color of their wing quills which are browner, less dark.

THE INDIAN RACES OF *Sitta europaea*

Meinertzhagen (1927, Ibis, p. 410) and Deignan (1945, Bull. U. S. Natl. Mus., no. 186, p. 317) have treated *S. cashmirensis* and the chestnut-bellied nuthatches (*S. castanea* and its allies) as races of *S. europaea*. All these forms are strict geographical representatives, and in my region, furthermore, the intermediate and geographically intervening *cashmirensis* is the link that connects the heavily saturated and sexually dimorphic races of the *castanea* type to the paler races of the *europaea* type in which the sexes are alike. In *cashmirensis* the male is darker below than the female, but the sexual difference is very far from being as marked as in the races of the *castanea* type, and female *cashmirensis* is very similar to female *europaea* (subspecies *caesia* and *rubiginosa*).

The chestnut-bellied nuthatches have been reviewed, under the specific name of *S. castanea*, by Whistler and Kinnear (1932, Jour. Bombay Nat. Hist. Soc., vol. 35, p. 522) who recognize four races: *almorae* Whistler, 1930 (type locality, Ramganga Valley between Almora and Pethora), for the population of the western Himalayas; *cinnamomventris* Blyth, 1842 (type locality, Darjeeling), for the populations of "Nepal and eastern Himalayas to Assam"; *castanea* Lesson, 1830 (type locality, Bengal), for the birds of "India"; the authors separating from the last the population of the upper Eastern Ghats as *prateri* Kinnear and Whistler, 1932 (type locality, Vizagapatán district).

I find that the population of northeastern Assam from Margherita and the Patkai Hills constitutes an undescribed race, which I propose to name

***Sitta europaea koelzi*, new subspecies**

TYPE: A.M.N.H. No. 683925; Rothschild Collection; adult female; Patkai Hills, Assam-Burma border; September 2, 1888; Ernst Hartert, collector.

SUBSPECIFIC CHARACTERS: The adult female differs from the adult females of the races listed above, and from the adult female of *neglecta* from Burma, by the much richer cinnamon of the under parts; above, by being slightly darker than *cinnamoventris* and *almorae*, and considerably darker than the others.

The adult males of *koelzi* are not separable from comparative specimens of *cinnamoventris*, and the measurements of *koelzi* in both sexes are similar to those of *cinnamoventris*.

The difference in coloration is not due to wear or to the age of the specimens. The plumage in all the *koelzi* female specimens is fresh, and both old and recently collected female specimens of the other races in fresh or worn plumage lack the strong and rich cinnamon tint.

RANGE: The range of *koelzi* is probably continuous southward from the Patkai Hills through the Naga Hills to the Barail Range in northern Cachar, for in the last region an adult female taken at Mahur on April 9 is identical with the females from Margherita and the Patkai Hills; a juvenal female in worn plumage taken at Guilang on May 12 is paler but still shows the rich cinnamon tint. In the neighboring Khasia Hills the population is not separable from that of *cinnamoventris* from Sikkim.

GEOGRAPHICAL VARIATION IN THE INDIAN RACES: The variation affects both size and coloration.

MEASUREMENTS: The measurements given in table 2 show that the populations from the hills of Assam, along the Himalayas, and from eastern Afghanistan have similar measurements, the more western populations tending to have a slightly longer wing. All these populations of the subspecies *koelzi*, *cinnamoventris*, *almorae*, and *cashmirensis* have a longer wing, and a longer, much heavier bill than populations of *castanea* from the lowlands of northern India, and from central, peninsular, and southern India. In separating the population of the upper Eastern Ghats from *castanea*, Kinnear and Whistler stated that in this population

(*prateri*) the bill was longer than in *castanea*. I have no specimens from the upper Eastern Ghats but in three specimens from neighboring Bastar, the bill is not different in size or shape from populations of *castanea* from United Provinces, Bihar, Surguja, northern Central Provinces, and Mysore. Kinnear and Whistler give the bill length of their specimens from the upper Eastern Ghats as "5♂ 21-22, 6♀ 20-22." The bill length of my specimens of *castanea* in table 2 for 27 males is 18.5-21.5 (20.4), for 21 females, 18.7-21.0 (19.8). The difference does not seem large enough to warrant separation, and there is too much overlap, 10 of my males having a bill length of 21 or more, and nine females a bill length of 20 or more.

COLORATION: Coloration varies more than the measurements. In the specimens examined this variation is as follows:

In two specimens from Kashmir and four from eastern Afghanistan (*cashmirensis*) males are much paler below, less rufous, and females are buffier, less rufous, than in any of the other populations. In the specimens of *koelzi* from Margherita, Patkai Hills, and northern Cachar, females are, as stated, much richer cinnamon below.

Specimens from Kumaon and Tehri (*almorae*) and from Sikkim (*cinnamoventris*) are darker above; below, the males are more rufous, the chestnut being more cinnamon, less brown and dark, and the females less "pinkish" than specimens of *castanea* from United Provinces, Bihar, Surguja, northern Central Provinces, Bastar, and Mysore. All these populations of *castanea* are very constant.

The specimens of Kumaon and Tehri (*almorae*) differ from those of Sikkim (*cinnamoventris*) by being paler below in the male and slightly paler in the females. Specimens from lower Nepal are intermediate but on the whole closer to *almorae*. Recently collected adult males from the Khasia Hills are a little darker below than the specimens from Sikkim; however, the latter are old and the difference appears to be due to the age of the skins. In any case the differences in the case of the Nepal and Khasia Hills populations are much too slight to warrant separation.

Specimens from the upper Eastern Ghats are not available. In separating this population as *prateri*, Kinnear and Whistler stated that, in addition to its having a longer bill (discussed above), it differed from *castanea* by being paler below in the male, and by having narrow pale subterminal bands on the under tail coverts.

The authors presumably imply that these pale bands are lacking in *castanea*, but in my specimens of the latter they are present or absent in specimens of both sexes as follows:

PRESENCE OR ABSENCE OF PALE SUBTERMINAL BANDS ON THE UNDER
TAIL COVERTS OF *S e castanea*

Region	Absent	Faint Trace	Present
United Provinces	3	5	10
Surguja	1	2	4
N. Central Provinces	4	6	10
Bastar	0	0	3
Mysore	1	1	0

Pending confirmation of a sufficiently distinct difference in the coloration of the under parts of the males, I believe that *prateri* should be considered as synonymous with *castanea*.

The pale subterminal bands on the under tail coverts are lacking in *cashmirensis* and are broadly present in *almorae*, *cinnamoventr*, and *koelzi*.

ECOLOGY: In northern India, where the large, heavy-billed forms meet the smaller and thin-billed *castanea*, the larger birds are restricted to the hills and *castanea* to the plains where it occurs around the towns. Elsewhere in central, peninsular, and southern India, where the large forms do not occur, *castanea* is found on both low and high ground. Koelz collected both on October 28 at Lechiwala in Kumaon, but although Lechiwala could not be located, it appears to be in the lower part of Kumaon where the lowlands and foothills meet. Undoubtedly members of Dr. Koelz' party collected in different directions, and, although no notes as to elevation appear on the labels, a few miles would make an important difference. Apparently the ecological separation is sharp and prevents interbreeding, as no intermediates are found.

MOULT: Adults have a complete postnuptial moult and juvenals moult into first winter plumage through a partial postjuvinal moult through which only the body plumage, lesser and middle upper wing coverts, and sometimes (two specimens out of 12) the top pair of rectrices are replaced. Both moults take place at the same time of the year. First winter specimens can be distinguished from adults by their distinctly browner wing quills but only when the latter are in fresh or not too badly worn plumage. The body plumage appears to be the same in both.

TABLE 2
MEASUREMENTS OF ADULTS AND FIRST WINTER BIRDS IN
SOME POPULATIONS OF *Sitta europaea*

Race and Region	Wing	Individual Bill Lengths
<i>cashmirensis</i>		
Kashmir	1 ♂, 86; 1 ♀, 81	♂, 21; ♀, 21
E. Afghanistan	1 ♂, 86; 3 ♀, 83.5, 84, 85	♂, 22.5; ♀, 22.5, 22.8, 23.5
<i>almorae</i>		
Kumaon, Tehri	12 ♂, 82-87 (84.3); 7 ♀, 81-84.5 (82.8)	♂, 22, 22, 22.5, 22.5, 22.5, 22.7, 22.8, 23, 23, 23, 23.2, 23.3, 23.5, 24.7; ♀, 22, 22.5, 22.5, 22.8, 23, 23, 23.5*
Lower Nepal	11 ♂, 81-85 (84.0); 3 ♀, 79, 81, 84	♂, 22.3, 22.5, 22.5, 23, 23, 23.5, 23.5, 23.5, 24, 24.2; ♀, 21.7, 22.2, 23
<i>cinnamomventris</i>		
Sikkim	6 ♂, 80-84 (81.7); 2 ♀, 79, 82	♂, 22, 22.3, 22.5, 22.7, 23, 23; ♀, 21.5, 22.5
Khasia Hills	4 ♂, 81, 82, 82, 84; 1 ♀, 81	♂, 22.8, 23, 23, 24; ♀, 21.5
Assam, Patkai Hills	2 ♂, 80, 81; 4 ♀, ^b 76-81.5 (79.4)	♂, 21.5, 24; ♀, 22, 22, 22.3, 22.5
N. Cachar	3 ♂, 80, 81, 82; 2 ♀, 77, 80	♂, 22, 22.5, 23; ♀, 21.8, 22
<i>castanea</i>		
Kumaon, W. United Provinces	1 ♂, 76.5; 3 ♀, 73, 74, 75.5	♂, 19.3; ♀, 19, 19, 21
E. United Provinces, Bihar	9 ♂, 71-77 (74.0); 4 ♀, 70.5, 71, 71, 71	♂, 19.2, 20, 20.2, 20.2, 20.5, 21, 21, 21.5, 21.5; ♀, 19, 19.5, 20, 20.5
Surguja	3 ♂, 73, 77, 79; 3 ♀, 73, 74.5, 75	♂, 21, 21, 21.5; ♀, 19, 20.5, 20.7
N. Central Provinces	8 ♂, 71-78.5 (74.7); 7 ♀, 71.5-73.5 (72.3)	♂, 18.5, 19.3, 19.3, 19.7, 20, 20, 20.2, 20.2, 20.5, 21, 21.2; ♀, 18.7, 19, 19.2, 19.5, 19.5, 19.5, 20, 20.5, 20.5
Bastar	2 ♂, 77, 79; 1 ♀, 72	♂, 20.3, 20.5; ♀, 20.5
Mysore	1 ♂, 78; 1 ♀, 76	♂, 21.5; ♀, 19.5

* The discrepancy in this and other populations between the number of wing and bill measurements is due to the moult.

^b Type of *koelsi*, adult female: wing, 80 (old quills); tail, 37 (moult nearly finished); bill, 22.

***Sitta europaea cashmirensis* Brooks**

EASTERN AFGHANISTAN: Above Khudi Khel, 8000 feet, May 22, 1937, 1 ad. ♀; Daulatshah, June 1, 1 ad. ♂, 1 subad. ♀; Kail, June 3, 1 ad. ♀.

***Sitta europaea almorae* Whistler**

NORTHERN INDIA: Tehri: Junana, September 16, 1948, 1 ad. ♂, 1 ad. ♀. Kumaon: Kathgodam, April 8-18, 2 ad. ♂, 1 subad. ♂, 1 ad. ♀; Askot, August 2-3, 1 ad. ♂, 2 subad. ♀; Berinag, August 6, 1 subad. ♂, 1 ad. ♀; Barichina, August 10, 1 ad. ♂; Lechiwala, August 31-November 3, 6 ad. ♂, 1 subad. ♂, 2 ad. ♀, 2 subad. ♀. Nepal: Simra, March 5, 1947, 1 ad. ♂; Amlekganj, March 6-9, 2 ad. ♂, 1 ad. [♀], 1 subad. ♀; Bhimpedi, March 13, 1 ad. ♂, May 6, 1 ad. ♂; Thankot, March 22, 1 ad. ♀; Hitaura, May 13-June 19, 6 ad. ♂, 2 imm. ♂, 1 subad. [♀], 3 unsexed imm.

***Sitta europaea cinnamoventris* Blyth**

INDIA: Khasia Hills: Umran, April 4, 1949, 1 ad. ♂; Nongpoh, April 26, May 1, 1 ad. ♂, 1 ad. ♀; Bara Pani, May 18-June 14, 2 ad. ♂.

***Sitta europaea castanea* Lesson**

INDIA: Kumaon: Lechiwala, October 28, 1948, 1 ad. ♂. United Provinces: Allahabad, April 15, 1937, 1 imm. ♂; Benares, January 24, 1947, 1 ad. ♂, 1 ad. ♀; Gorakhpur, January 28, 1 ad. ♂, 1 ad. ♀; Siswa Bazar, January 30, 1 ad. ♂; Nichlaul, January 31-February 4, 2 ad. ♂, 2 ad. ♀. Bihar: Raxaul, March 1, 1 ad. ♂; Patna, April 4, 1937, 1 ad. ♂. Surguja: Ramanujganj, October 6-7, 1947, 1 ad. ♂, 1 ad. ♀; Gargori, October 20-24, 2 ad. ♂, 2 ad. ♀. Central Provinces: Bichhia, July 1-11, 1946, 1 ad. ♀, 1 subad. ♀; Mandla, June 21-28, 1 ad. ♂, 2 subad. ♂, 1 ad. ♀, 2 subad. ♀, October 14-15, 2 ad. ♂, December 2-3, 1947, 1 ad. ♂, 1 ad. ♀; Belwani-Kisli, August 5-September 26, 1946, 5 ad. ♂, 3 subad. ♀. Bastar: Taroki, March 19-20, 1949, 1 ad. ♂, 1 ad. ♀; Korher, March 22, 1 ad. ♂.

***Sitta leucopsis leucopsis* Gould**

EASTERN AFGHANISTAN (NEAR GARDEZ): Sirotai [Saroti], June 20, 1937, 3 ad. ♂.

INDIA: Northern Punjab, Chamba: Kukti, July 4, 1936, 1 ad. ♂, 1 imm. ♂, 1 ad. ♀, 1 imm. ♀. Northern Punjab, Lahul: Tsokang Nulla, October 19-21, 2 ad. ♂, 3 imm. ♂, 2 ad. ♀, 1 imm. ♀; Muling, October 24, 1 ad. ♀. Northern Punjab, Kulu: Rahla, October 26, 1 ad. ♂; 8000 feet above Bandrole, November 13, 1 ad. ♀, 1 subad. ♀.

Adults taken on June 20 in Afghanistan and July 4 in Chamba are just starting a complete moult, and a few last traces of moult still show on specimens taken on October 19 and 26 in Lahul and Kulu.

MEASUREMENTS: Wing, seven males, 76-81 (79.0); five females 76-81 (78.4). Tail, seven males, 39-45 (42.1); five females, 40-

44 (41.0). Bill, seven males, 21-22 (21.6); five females, 21-22 (21.4).

Sitta himalayensis himalayensis Jardine and Selby

INDIA: Tehri: Kadukal, September 11, 1948, 1 ad. ♂, 1 ad. ♀; 10,000 feet above Luni, September 24, 2 ad. ♂, 1 ad. ♀; Kanderala, October 18-20, 1 ad. ♂, 2 ad. ♀. Kumaon: Dhakuri, April 26-27, 2 ad. ♂; Shankala, July 24, 1 subad. ♀; Galla, July 26, 1 ad. ♀; Sanandin, August 3-4, 1 ad. ♂, 1 unsexed ad. Nepal: Chitlang, March 15, 1947, 1 ad. ♂, 1 imm. ♂, 2 ad. ♀, 1 imm. ♀; Thankot, March 21-April 6, 2 ad. ♂, 3 ad. ♀; Deorali [near Chisapani Garhi], May 1, 1 ad. ♂; Bhimpedi, May 6-8, 1 imm. ♂, 1 unsexed imm. Bengal: Rangirum, December 26, 1936, 2 ad. ♂, 2 ad. ♀.

These specimens were compared to the specimens in the collection of the American Museum of Natural History from Sikkim, northern Burma, northwestern Yunnan, and Tonkin. The geographical variation in coloration is slight. In comparative plumage, specimens from Tonkin and, to a lesser degree, from northern Burma and northwestern Yunnan are a little paler on the throat,

TABLE 3
INDIVIDUAL MEASUREMENTS IN *Sitta himalayensis*

Region	Wing	Tail	Bill
<i>Sitta himalayensis himalayensis</i>			
Tehri	♂ 76, 76.5, 77, 77 ♀ 71, 72.5, 74, 74	36, 36.5, 37.5, 38 33, 34, 36, 37	17, 17.7, 18, broken 17, 17.2, 17.7, 18
Kumaon	♂ 74, 75, 76 ♀ 72, 76, moult " 75, 76	36.5, 38, moult 34 5, 35, moult 36, 37.5	17, 17.5, broken 17, 17.2, 18 17, 18
Nepal	♂ 71, 71.5, 74, 76 ♀ 72, 72, 72, 72.5, 73	35, 36, 36, 38 35, 35, 36, 37 5, 38	17, 17, 17.3, 18 16 5, 17, 17, 17, 18
N. Bengal and Sikkim	♂ 73, 75, 75.5, 76 ♀ 69, 70.5, 72, 73, 76 " 72, 74, 75, 75	35, 36 5, 38, 38 34, 34.5, 35, 37, 40 34, 37, 37, 40	17, 17, 18.2, broken 17, 17, 17.5, 17.5, 18 17, 17.2, 17 2, 17.5
<i>Sitta himalayensis whistleri</i>			
N. Burma	♂ 70.5, 71, 72, 75 ♀ 70, 71, 74 " 72.5	35, 35 5, 36, 38 36, 36, 36.5 39	15, 16, 16.2, 16.2 15.5, 16, 16 16.5
N. W. Yun- nan	♂ 72 ♀ 70, 71	38 35, 35	16 2 15, 15.5
Tonkin	♂ 70.5, 71 ♀ 69 " 69	36, 36 35 34	16, 16 15.5 15.5

" Unsexed.

and the upper breast is more yellowish, less rich, than in specimens from farther west in the Himalayas.

Table 3 shows that a cline of decreasing size runs from west to east. There is a good deal of overlap, but the wing length in specimens from Burma, Yunnan, and Tonkin averages definitely smaller. In the case of the bill the difference is well marked: 35 specimens of both sexes from Tehri to Sikkim have a bill of 16.5–18.2 (17.3), and 15 from northern Burma to Tonkin, 15.0–16.5 (15.8); only one measurement overlaps. The population from northern Burma has the short bill of the birds of Tonkin, but, as mentioned by Mayr (1941, *Ibis*, p. 56), it is intermediate as regards the length of the wing.

MOULT AND BREEDING: Adults taken at the end of July and the first few days of August in Kumaon are nearing the end of a complete moult. A specimen taken on September 11 in Tehri still shows a very few last traces.

This species apparently breeds early, as breeding specimens were taken in lower Nepal from March 15 to April 6.

Sitta frontalis frontalis Swainson

SYNONYMS: *Sitta frontalis corallina* Hodgson.

Sitta frontalis simplex Koelz.

INDIA: Kumaon: Kathgodam, April 9–12, 1948, 4 ad. ♂; Lechiwala, August 31–November 1, 6 ad. ♂, 8 ad. ♀. Nepal: Simra, March 4–5, 1947, 4 ad. ♂; Bhimpedi, May 5, 1 ad. ♂; Hitaura, May 11–June 15, 2 ad. ♂, 1 imm. ♂, 3 ad. ♀, 1 unsexed imm. Northern Bengal: Darjeeling district, Badamtam Forest, Rangit, December 24, 1936, 1 ad. ♂, 1 ad. ♀. Khasia Hills: Umrang, April 9–14, 1949, 2 ad. ♂, 1 imm. ♀; Nongpoh, April 23–May 2, 1 imm. ♂, 1 imm. ♀; Barnihat, May 31, 1 ad. ♀; Bara Pani, June 9, 1 imm. ♀. Northern Central Provinces: Belwani-Kisli, July 25–August 1, 1946, 1 subad. ♂, 2 ad. ♀, 2 subad. ♀, September 28, 1 ad. ♂; Kanha, August 22–September 18, 4 ad. ♂, 1 ad. ♀, 1 unsexed subad. Orissa: Mahendra, January 24–25, 1937, 1 ad. ♂, 2 ad. ♀. Bastar: Taroki, March 20, 1919, 1 ad. ♂. Southern Bombay Presidency: Londa, January 9–22, 1938, 4 ad. ♂, 3 ad. ♀, January 31, 1 ad. ♂ (the type of *S. f. simplex*); Jagalhed, March 10, 1 ad. ♂. Nilgiri Hills: Ootacamund, February 14–16, 1937, 2 ad. ♂, 3 ad. ♀; Kunjapanai, February 19, 1 ad. ♀. Palni Hills: Kodaikanal, March 10, 1 ad. ♀.

Ticehurst (1926, *Jour. Bombay Nat. Hist. Soc.*, vol. 31, p. 491) has remarked that the populations found along the Himalayas are "smaller than the Ceylon bird in wing and bill, and should stand as *Sitta frontalis corallina* Hodgson." This statement is supported by Whistler (1932, *Jour. Bombay Nat. Hist. Soc.*, vol. 35, p. 523) who finds that "Birds from the Nilgiris, Palnis, and Travancore

agree with those of Ceylon . . . [and] As measurements alone distinguish the races and intergradation occurs in the few specimens available from the range of the bird between the Nilgiris and the Himalayas it will be convenient to consider all birds south of the Indo-Gangetic plain as belonging to the typical race."

This treatment is unsatisfactory because, while it is true that the southwestern populations tend to be larger, both large and small birds are found in the peninsular populations (see list of individual measurements below). Since the measurements of the peninsular populations completely or virtually overlap those of the Himalayan and southwestern populations, and since Whistler's measurements show that topotypical *frontalis* from Ceylon tends again to be small, I believe that it is wiser not to separate the various Indian populations.

Koelz (1939, Proc. Biol. Soc. Washington, vol. 52, p. 63) has separated the population from southern Bombay as *simplex*, stating that "Compared with specimens of *frontalis* from Ceylon in the Rothschild Collection, these Indian specimens are less richly colored and without the strong lilac purple tone that characterizes the typical form." In *simplex* Koelz includes specimens taken in the Nilgiris, the Palnis, and southern Orissa. Koelz, however, lacked proper comparative material, the Ceylon specimens in the Rothschild Collection consisting of only three skins, one undated but ancient, and the other two taken in 1868. These skins are darker below than Koelz' specimens, but they are badly foxed, and old foxed specimens taken in Sikkim from 1870 to 1888 show an identical darkening of the delicate lilac coloration. Fresh skins taken in the Himalayas, northern India, peninsular, and southwestern India from 1936 to 1949 vary very slightly, but no definite geographical trend is apparent. Whistler (1944, Spolia Zeylanica, vol. 23, p. 130) found that specimens taken in Ceylon from 1936 to 1939 were inseparable from the populations of southwestern India.

MOULT: Adults have a complete postnuptial moult, and juvenals moult into first winter plumage through the usual partial postjuvénal moult. Except at the time of the moult, adult and first winter plumages cannot, apparently, be distinguished. The moult probably starts towards the end of June, for specimens taken on June 15 in lower Nepal, though extremely worn, show no signs of moult, whereas it is well advanced in specimens taken on July 25 in the Central Provinces. The moult continues through

August and is almost ended in a specimen taken on September 1 in Kumaon, and a few last traces still show on specimens taken on September 18 in Central Provinces. In Ceylon, Whistler (1944, *loc. cit.*) found that the moult also took place in July and August.

Individual wing and bill measurements in Indian populations are as follows:

Kumaon: Wing: males, 71, 73, 73, 73.5, 73.5, 74, 75, 75, 76.5, 77; females, 70, 70, 73, 73, 73, 73, 74. Bill: males, 15, 15.2, 15.5, 15.5, 15.5, 15.6, 16, 16, 16; females, 15.5, 15.5, 15.6, 15.7, 15.7, 15.7, 15.8, 16.

Nepal: Wing: males, 72, 72.5, 72.5, 74, 75, 75, 77; females, 69, 72, 72.5. Bill: males, 15.5, 15.5, 16, 16, 16.2, 16.5; females, 15.7, 16, 16.5.

Northern Bengal: Sikkim: Wing: males, 73.5, 74.5, 76, 77; females, 71, 72.5. Bill: males, 16, 17, 17, 17; females, 16.5, 16.5.

Northern Assam (Dibrugarh): Wing: female, 72.5. Bill: female, 15.5.

Garó Hills: Wing: male, 74.5; females, 72, 75. Bill: male, 16.2; females, 16.5, 17.5.

Khasia Hills: Wing: males, 75.5, 77.5; female, 73. Bill: males, 16.2, 17.2; female, 15.

Northern Cachar: Wing: male, 72; female, 73. Bill: male, 16.2; female, 16.

Central Provinces: Wing: males, 71, 73.5, 74.5, 76.5, 77.5; female, moulting. Bill: males, 16, 16, 16, 16.7, 17; female, 15.5, 16, 17.

Orissa: Wing: male, 79; females, 73, 74. Bill: male, 15.5; females, 15, 16.4.

Bastar: Wing: male, 74. Bill: male, 16.4.

Southern Bombay Presidency (Londa and region): Wing: males, 72, 74, 75, 76, 76, 77.5; females, 72.5, 72.5, 74. Bill: males, 15.5, 15.7, 16, 17, 17.5, 17.7; females, 16, 16.5, 17.

Mysore: Wing: male, 78; females, 72.5, 75. Bill: male, 16; females, 16.5, 17.

Shevaroy Hills: Wing: females, 70, 73.5. Bill: females, 16, 16.2.

Nilgiri Hills: Wing: males, 80, 80, 82; females, 74, 75, 76, 77, 79.5. Bill: males, 17, 17, 17.2; females, 15, 15.5, 16.5, 16.8, 17.

Travancore and Palni Hills: Wing: females, 72, 73, 74, 75.5. Bill: females, 15.5, 16.8, 17, 17.

Ceylon: Wing: males, 78, 79; female, 75. Bill: males, 16.5, 16.5; female, 16.2.

Ceylon (Whistler, 1914, *Spolia Zeylanica*, vol. 23, p. 130): Wing: eight males, 75-81.5; eight females, 73.5-77.5. Bill: eight males, 16-17; eight females, 15.5-17.

SITTA NEUMAYER AND *SITTA TEPHIRONOTA*

The ranges of the rock nuthatches, *S. neumayer* and *S. tephronota*, extend from southeastern Europe through western Asia to the western Tian Shan in Turkestan. The first, *S. neumayer*, is a western form which reaches its eastern limits in the mountains of

Kirman in southern Iran and in the region of Gurgan at the eastern end of the Elburz. The other, *S. tephronota*, reaches its western limits in Armenia and Kurdistan. Thus, over a large part of Iran, in the north, west, southwest, south, and parts of central Iran, the two species overlap. In the zone of overlap they occur side by side, and, with the possible exception of the Kirman

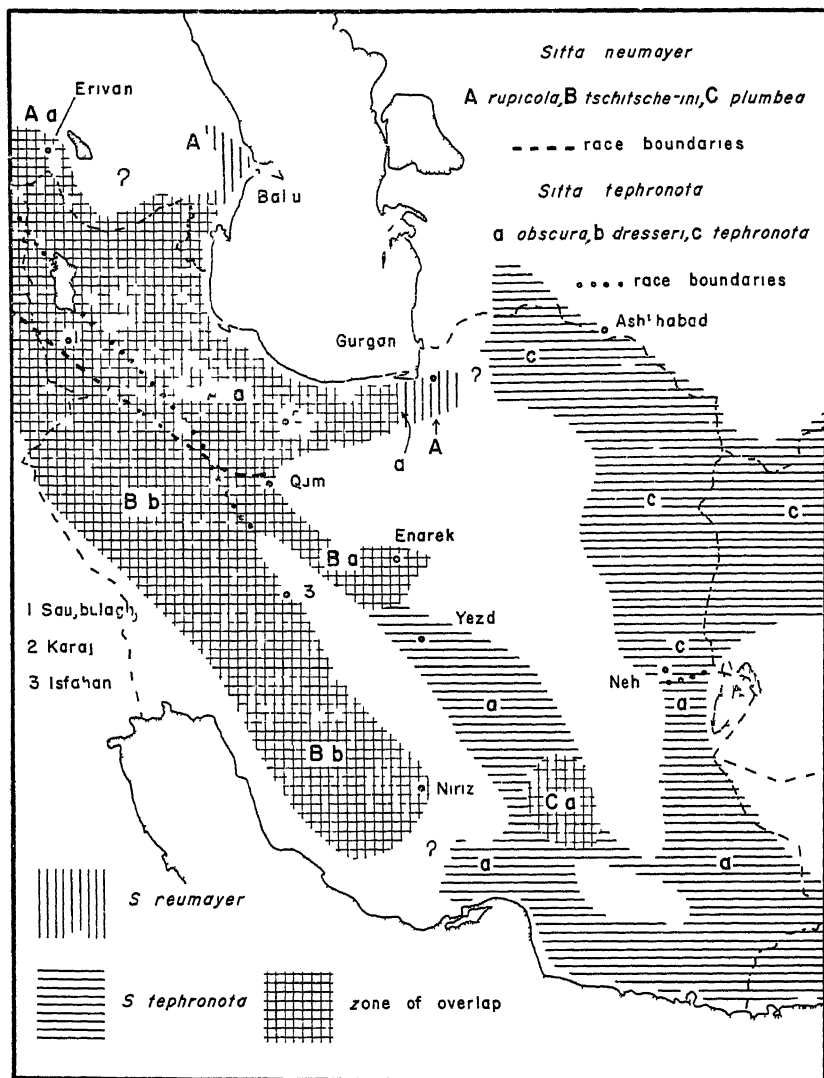


FIG 1 Distribution and overlap of *Sitta neumayer* and *S. tephronota* in Iran

population of *S. neumayer*, are apparently equally common. The distribution and overlap in Iran are shown in figure 1.

As these two species outside the zone of overlap are identical in pattern and are either identical or virtually so in size and coloration, the overlapping populations caused much confusion until the publication of the detailed paper by Zarudny and Härms (1923, Jour. Ornith., vol. 71, pp. 398-418). The correct status of the two species as a whole is also set forth in the papers of Jordans (1923, Falco, vol. 19, special no., pp. 18-20), and Stresemann (1925, Ornith. Monatsber., vol. 33, pp. 106-109).

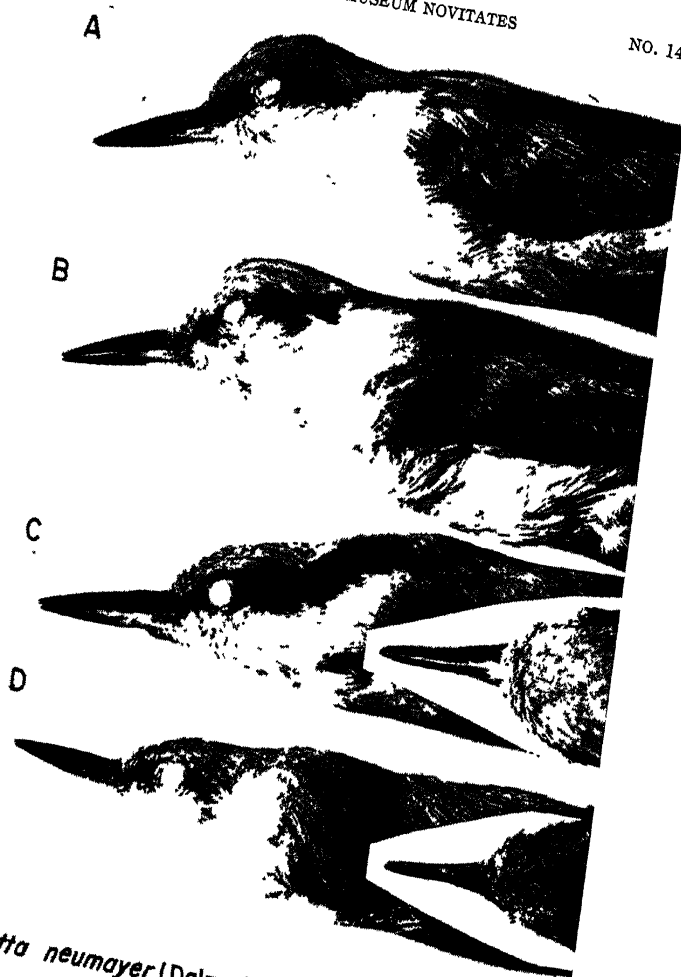
The large amount of material at hand, most of it consisting of the fresh and excellent series collected by Dr. Koelz in Iran and Afghanistan, offers an opportunity for review. This material consists of over 250 specimens, 173 collected by Dr. Koelz and the rest, which include a large share of the original specimens of Zarudny and Härms from eastern Iran, from the collection of the American Museum of Natural History.

As first indicated in the paper of Zarudny and Härms, populations from regions where the two species occur together are easy to separate. The races of *S. tephronota* in these regions are very large and have long and massive bills; conversely, the races of *S. neumayer* are small and have shorter and weaker bills. The size differences are accompanied by unmistakable differences in the development of the black facial stripe. The diverging characters are presented in tabular form (table 4). As the bill size appears to be of much significance, its size variations for the two species as a whole are illustrated in figure 3. The size and shape of the bill and facial stripe are illustrated in figure 2.

ECOLOGICAL SIGNIFICANCE OF THE CONTRAST IN CHARACTERS

David Lack has stated (1944, Ibis, p. 279) that "when two closely related species occupy the same habitat in the same region, they nearly always differ markedly in feeding habits and/or size."

The food habits of the rock nuthatches in Iran are scarcely known, but as far as size is concerned the two species fully support Lack's thesis. In table 4 it was shown that when they occur together they are easily separable by a marked difference in the length of the wing and the size and shape of the bill. There is

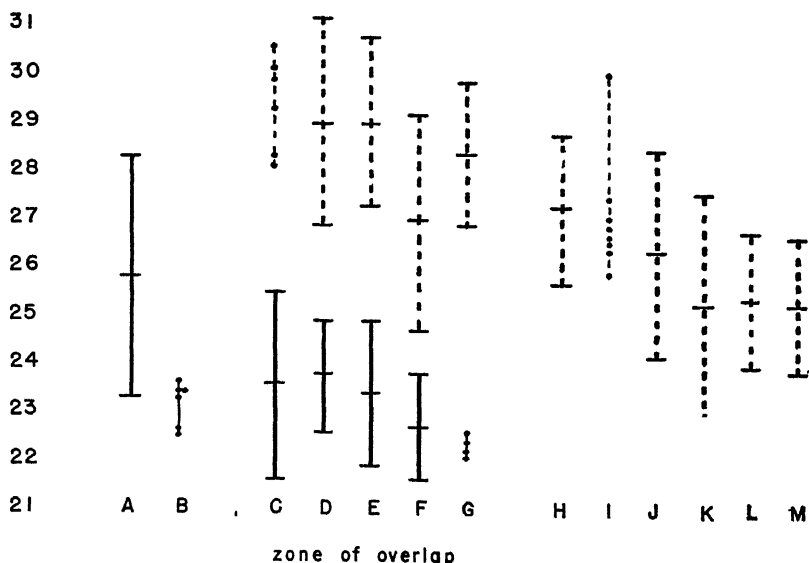


A, *Sitta neumayer* (Dalmatia)-B, *S. tephronota* (Ferghana)
C, *S. tephronota* - D, *S. neumayer* (both Durud Luristan).

FIG. 2. Shape and size of the bill and facial stripe in *Sitta neumayer* and *Sitta tephronota*.

also a conspicuous difference in the facial stripe, even though the general coloration of the rest of the plumage remains the same.

32 mm Bill length



solid lines = *Sitta neumayer*

broken lines = *Sitta tephronota*

FIG. 3. Graphic illustration of the bill length (measured from skull) in *Sitta neumayer* and *Sitta tephronota*. In the zone where the distribution of the two species overlaps, measurements pull conspicuously apart, but outside this zone, west and east in the case of these two species, measurements are similar. Horizontal markings represent the mean and two standard deviations above and below. Where sample is insufficient, individual specimens are represented by dots.

Populations west of the zone of overlap (*S. neumayer*): A, Dalmatia and Greece; B, Asia Minor. In the zone of overlap: C, Azerbaijan and northern Iran; D, Kermanshah; E, Luristan and Bakhtiari; F, Fars; G, Kirman. East of the zone of overlap (*S. tephronota*): H, Persian Baluchistan; I, southern Afghanistan (mostly Kandahar); J, Khorasan; K, north central Afghanistan north of the Hindu Kush; L, northeastern Afghanistan (Pamirs); M, Ferghana and western Tian Shan.

Presumably, if the two species are not to compete, the difference in the feeding organ should be the most important, as the far heavier and longer bill implies adaptation for the taking of different food.

Figure 3 illustrates conclusively the conspicuous difference in the zone of overlap. Outside this zone bill measurements become similar as the populations pull farther apart. It may also be added that in the more distant populations the difference in shape

TABLE 4
 CONTRASTING CHARACTERS IN OVERLAPPING POPULATIONS OF *Sitta neumayer* AND *S. tephronota*
 (For variations in bill size, see figure 3)

Race and Region	N	Wing and its Length	Bill	Facial Stripe
Elburz and Azerbaijan				
<i>S. n. ruficola</i>	20 ♂ ♀	Short, 75.0-81.0 (78.4)	Short, weaker and more compressed laterally	Well developed
<i>S. t. obscura</i>	2 ♀	Long, 88, 90	Long, massive and more swollen laterally	Very prominent (longer and at least twice as broad)
Elburz (Kara)	4 ♂ ♀	Very long, 94-96.5 (95.1)	Still longer and heavier than in <i>S. t. obscura</i>	Still more prominent than in <i>S. t. obscura</i>
<i>S. t. dresseri</i>				
Azerbaijan				
Zagros				
<i>S. n. tschitscherini</i>	45 ♂ ♀	Short, 73.0-81.0 (77.2)	As in <i>S. n. ruficola</i> but averaging still shorter	Very poorly developed, blackish instead of pure black
<i>S. t. dresseri</i>	34 ♂ ♀	Very long, 87.0-100.5 (94.0)	Long and massive (as in Azerbaijan)	Very prominent (as in Azerbaijan)
Kirman				
<i>S. n. plumbea</i> ^a	4 ♂ ♀	Short, 75.0-78.0 (76.2)	Shortest and weakest	Very poorly developed (as in <i>S. n. tschitscherini</i>)
<i>S. t. obscura</i>	13 ♂ ♀	Long, 88.0-97.0 (91.5)	Long and massive (as in Kara)	Very prominent (as in <i>S. t. dresseri</i>)

^a In addition, *S. n. plumbea* differs from all known populations of *S. neumayer* and *S. tephronota* in the color of its throat and breast which are ashy instead of white or creamy.

no longer exists, and, as stated above, the wing length, pattern, and general coloration are identical or virtually so.

SITTA TEPHRONOTA

As *S. tephronota* is quite variable geographically and the variation is bound to be confusing, it is best visualized in tabular form (table 5) and, since measurements have been used so extensively for discrimination, the significant ones (wing and bill) are given individually. As it is not always possible to distinguish between adult and first winter plumage, the measurements given in the literature probably include those of a certain number of specimens that are not fully adult. In this review of the rock nuthatches, therefore, the measurements of all specimens are given, except those obviously juvenal. Capital letters refer to the populations in table 5.

The various populations of *S. tephronota* can be grouped under three forms:

1. *Sitta t. tephronota* Sharpe, 1872 (type locality, Kokand, Ferghana). This form ranges westward from western Tian Shan through Ferghana, Pamirs, and Afghanistan to Khorasan. Its populations vary geographically.

In the specimens examined, the most northern populations (A) from Tian Shan, Ferghana, northeastern Afghanistan, and from the Russian-Iran border in Transcaspia are identical in coloration and have similar measurements. Buturlin separated the population from the "Russian-Persian Frontier in Transcaspia" as *iranica* on the basis of being smaller and of having a shorter bill. The measurements given in this review show that this is not tenable, and "*iranica*" has already been made a synonym of nominate *tephronota* by Dementiev (1934, L'Oiseau, p. 625).

Meinertzhagen (1938, Bull. Brit. Ornith. Club, vol. 58, p. 96) in describing as *subcaeruleus* specimens taken at Haibak in Afghan Turkestan stated that they were paler and bluer on the mantle and less rusty than specimens of nominate *tephronota* "from Russian Turkestan, East Persia, and Beluchistan." My specimens from north central Afghanistan north of the Hindu Kush (B) agree with the differences cited by Meinertzhagen and are also slightly whiter on the throat and upper breast than in the other populations of nominate *tephronota*. But in my material, populations from "Russian Turkestan" (A) and "East Persia" (C) vary in coloration from each other, and from the population of north cen-

TABLE 5
GEOGRAPHICAL VARIATION IN *Sitta tephronota*

Race and Populations	Size (Wing)	Bill	Mantle	Facial Stripe	Under Parts
<i>S. t. tephronota</i> A Tian Shan, Ferghana, N. E. Afghanistan, Transcaspian border	Small	Shorter, less massive (more compressed laterally)	Blue gray (rather dull)	Less prominent, (narrower and not extending so far back)	Throat and upper breast whitish or creamy, ab- domen rusty; rust rather dull and pale, not sharply separated from color of breast
B N. central Afghanistan (north of Hindu Kush)	Small (as in A)	As in A	Slightly paler, clearer and slightly bluer than in A	As in A	Throat and upper breast slightly whiter, rust not sharply separated (as in A), rust being perhaps very slightly paler
C Khorasan	Small (as in A and B)	Slightly longer and thicker than in A and B	Slightly darker than in A	Slightly more prominent than in A and B	Throat and upper breast as in A, but more rust and rust darker, not sharply separated (as in A and B)
D S. Afghanistan	Small (as in A, B, C)	As in C	As in C	As in A and B	Throat and upper breast as in A, rust slightly darker than in A, slightly paler than in C, not sharply separated (as in A, B, C)

INDIVIDUAL MEASUREMENTS IN *Sitta tephronota**Sitta t. tephronota*

A. Tian Shan: Wing, male, 87.5; female, 86, 90. Bill, male, 25.2; female, 26, 26. Ferghana: Wing, male, 84, 85, 88; female, 85, 86, 86. Bill, male, 24.8, 24.9, 26.7; female, 24.3, 24.8, 25.2. Northeastern Afghanistan (regions of Faizabad and Zebak): Wing, male, 84, 86, 87, 88; female, 84, 85, 87.5, 88. Bill, male, 24.7, 26, 26.1, 26.3; female, 24.3, 25.1, 25.7, 26.3. Transcaspiian border (mostly Ashkhabad): Wing, male, 84, 86, 88; female, 85, 85. Bill, male, 25.2, 25.2, 25.8; female, 25.8, 26.6.

B. North central Afghanistan (north of Hindu Kush): Wing, male, 85, 86, 87, 87, 88, 89; female, 85, 86, 88. Bill, male, 24.8, 25, 25.1, 25.2, 25.5, 26.1, 26.7, 26.8, 27.3, 27.6; female, 25, 25.5, 25.5, 25.5, 26.4, 29.3.

C. Khorasan (all but two south of Meshed): Wing, male, 83, 84, 85, 85, 86, 87, 87, 88, 88, 88, 89, 90, 90; female, 84, 84, 84, 85, 86, 86, 86, 87, 88, 88, 89. Bill, male, 25.6, 26.2, 26.2, 26.3, 26.5, 26.5, 26.6, 26.9, 27.1, 27.2, 27.2, 27.5, 27.5, 27.5, 28.2, 29, 29.6; female, 24.5, 24.6, 25.2, 25.5, 25.6, 25.7, 26.2, 26.3, 26.3, 26.3, 26.5, 26.6, 26.8, 27.4, 27.7.

D. Southern Afghanistan: Kandahar: Wing, male, 85, 88, 92; female, 85, 86. Bill, male, 26, 26.7, 27; female, 27.2, 30.2. Near Gardez: Wing, female, 88. Bill, female, 26.5. Shibar Pass: Wing, male, 89.5, 90. Bill, male, 26.8, 27.6.

Sitta t. obscura

E. Persian Baluchistan: Wing, male, 89, 90, 90, 90, 91, 91, 91.5, 92, 92.5, 93.5; female, 92. Bill, male, 26.2, 26.7, 27, 27.3, 27.4, 27.7, 27.7, 27.7, 28.5, 28.7; female, 26.2.

F. Kirman: Wing, male, 88, 89.5, 90, 91, 92, 92, 96.5, 97; female, 88, 88, 89.5, 91, 93. Bill, male, 27.3, 27.5, 28, 28.2, 28.2, 28.5, 28.8, 29.3, 29.8; female, 27.5, 28.2, 28.8, 29.2, 29.5. Yezd (Shir Kuh): Wing, female, 88. Bill, broken.

G. Northern Iran (Karaj): Wing, female, 88, 90. Bill, female, 28.2, 28.4.

Sitta t. dresseri

H. Fars: Wing, male, 93, 94; female, 87+, 87+, 88, 89+, 90, 93. Bill, male, 27.3, 28.3; female, 24.6, 26.3, 27.3, 27.5, 28, 28. Luristan-Bakhtiari: Wing, male, 95, 96, 97, 97, 98, 100.5; female, 93, 93, 94, 94, 95, 96. Bill, male, 27.9, 28.2, 29.4, 30, 30.5, 30.6; female, 28, 28.4, 28.6, 29.2, 29.3, 29.3. Kerman-shah: Wing, male, 92, 92, 94, 95, 96, 97, 98; female, 91, 91, 93, 93, 94, 96, 96.5. Bill, male, 28, 28.5, 28.8, 29, 30, 30.5, 30.8; female, 27.5, 27.5, 28.2, 29, 29.5, 29.7, 30.6. Western Azerbaijan (Saujbulagh): Wing, male, 95, 96.5; female, 94, 95. Bill, male, 30, 30.7; female, 29.4, 30.2.

tral Afghanistan (B) by the same degree of variation that any of the four populations of nominate *tephronota* differs from another. Further, in the population from north central Afghanistan, as well as in the other three populations, there is a certain amount of individual variation. Matching specimens can be found in any of the four populations, although, taken in series, the populations are separable by the differences given in table 5.

I believe therefore that it is wiser not to recognize *subcaeruleus* nomenclatorially. For if this population is formally separated, one should, in order to be consistent, give a name to all the variable populations of the species. Such excessive splitting only obscures the geographical variation and its trends. Moreover, the four populations should be kept together, as they have a great many characters in common such as small size, shorter, less massive bill, less prominent facial stripe, and lack of sharp separation between the white and rust of the under parts, which separate them distinctly as a group from the populations of *obscura* and *dresseri*.

In regard to the range of the pale population in north central Afghanistan, Meinertzhagen found the pale population only at Haibak, and in 1938 (Ibis, p. 672) observed that from there on south to the Dar e shikari Gorge (a gap of 100 miles) he found no rock nuthatches. South of the gorge he found the darker population. However, I have pale specimens from Baligali Pass [Balaghli], about 30 miles north of the gorge, and, from the Shibar Pass, about 15 miles south and east of the gorge, I have two specimens respectively typical of the pale (B) and dark (D) populations. It would appear that where local conditions permit, as along the mountain passes, the populations north and south of the Hindu Kush meet. The range of the pale population is sizable, extending at least as far west as Khami Deh, about 150 miles to the west of the Shibar.

2. *Sitta tephronota obscura* Zarudny and Loudon, 1905 (no type locality, the authors stating that the range of this form extends from Gilan and Mazenderan southeast through the Plateau to Persian Baluchistan). I have no specimens from Gilan and Mazenderan; the most northern specimens of *obscura* examined are from Karaj near Tehran. Southeast of this locality, specimens were examined from Yezd, Kirman, and Persian Baluchistan. In southeastern Iran my specimens of *obscura* show, as stated by Zarudny and Härms, that this form replaces nominate *tephronota* south of Bendan, or at about the level of Neh and northern Seistan. No specimens from Armenia and Baluchistan proper are available, but these populations are probably referable to *obscura*. Populations of *obscura* vary geographically.

In *obscura* the characters of this form are best shown by the population from Kirman and Yezd. This well-marked central population (F) is of course completely isolated from nominate *tephronota* by the great Kavir and deserts to the north and east,

and from *dresseri* by the wide desert plain and kavirs which separate the Zagros from the mountains of Yezd and Kirman. At both extremities where these ranges rejoin the mountains of the northwest and southeast, the two populations are intermediate. That of Persian Baluchistan in the southeast (E) is intermediate in every character between the Khorasan population of nominate *tephronota* (C) and the central population of *obscura* (F); the Persian Baluchistan population also approaches in characters the dark southern Afghanistan population (D) of nominate *tephronota*. The northwestern population of *obscura* (G), judging by only two specimens, is intermediate between *dresseri* and the central population from Kirman and Yezd.

In *obscura* also, it seems wiser, as in nominate *tephronota*, not to separate nomenclatorially the three populations.

Pending confirmation I believe that *armeniaca* should not be recognized. This population, described by Worobiev (1934, L'Oiseau, p. 156) from the region of Erivan in Armenia, was said to be near ("proche") nominate *tephronota* in coloration but larger and with a heavier bill. Worobiev's measurements do not separate the population of Armenia from *obscura*, nor does the heavier bill, and, in view of the geographical variation in coloration discussed above, the color difference does not appear diagnostic.

3. *Sitta tephronota dresseri* Zarudny and Buturlin, 1906 (type locality, Shiraz, Fars; based on Blanford's "large pale variety" whose specimens came from Shiraz, 1876, Eastern Persia, vol. 2, p. 223). This form is restricted to the Zagros, from Fars westward, and the prolongations of the Zagros into Kurdistan in Iraq and western Azerbaijan. Its populations vary little geographically.

The variation is clinal in character and affects the rust of the under parts. The rust gets less dark as the populations range northwest to southeast, or from Saujbulagh in western Azerbaijan through Kermanshah (Kurdistan) and Luristan and Bakhtiari to Niriz in Fars. The cline is very gradual and the difference at both ends much too slight to warrant separating the northwestern population as was done by Ticehurst. In addition to being more rusty, Ticehurst emphasized that his "*kurdistanica*" was the largest of the rock nuthatches, but the measurements of his five specimens fall within the range of variation of all the other populations of *dresseri*.

MOULT, PLUMAGES, AND BREEDING SEASON

Adults have a complete postnuptial moult, and juvenals moult into first winter plumage through a partial postjuvinal moult which involves only the replacement of the body plumage, lesser and median upper wing coverts, and, rarely (one specimen), the top pair of rectrices. Both moults take place at the same time of the year and start rather late, usually around the middle of July, though occasional individuals have started by the first few days of the month while others are starting only around August first. The moult is at its height from the middle of August to the middle of September and is usually over by the middle or latter part of October, but two or three specimens taken in Iran still show a few last traces around the middle of November and even on the first two or three days of December.

Specimens in first winter plumage cannot be distinguished with certainty from adults except in the fall or early winter. At this time of the year the adult wing quills, which are blacker, are fresher; those of first winter specimens, which are browner, are more worn since they were not replaced at the postjuvinal moult. Before the postjuvinal moult specimens in fresh juvenal plumage are tinged with delicate rust on the throat and upper breast and the feathers of the mantle have very narrow buffy terminal edges. Two juvenal males taken on April 25 at Marbirinji in Bakhtiari are in the last stages of the postnatal moult, this postnatal moult being a complete moult.

Sitta tephronota apparently breeds early as well as rather late. In Persian Baluchistan Zarudny took a female with an egg ready to be laid on February 15. Koelz collected laying females on March 9 in Bakhtiari and March 20 in Fars as well as on May 6 in Bakhtiari.

SITTA NEUMAYER

Three well-characterized races occur in Iran:

1. *Sitta n. ruficola* Blanford, 1873 (type locality, Karij Valley, Elburz). In this race the black facial stripe is well developed, the upper surface is distinctly darker than in *tschitscherini*, and bluer and brighter than in *plumbea*. In Iran it is found in Azerbaijan and in northern Iran, in the Elburz as far east as the region of Gorgan from where I have a specimen, and in the region which extends south of the Elburz to the great Kavir and the region to the north of Qum. According to Dementiev (1934, L'Oiseau, p.

624) it also occurs in Transcaucasia, and I have a specimen from Armenia taken at Mahmudie [Hosap] east of Lake Van.

2. *Sitta n. tschitscherini* Zarudny, 1904 (type locality, Isfahan). In this race the facial stripe is very poorly developed, and the upper surface is very pale, almost whitish gray. It is found in the Zagros where I have specimens ranging from Kermanshah to Niriz and Jahrum in Fars. According to Zarudny and Härms (*loc. cit.*) it is common also in the region of Isfahan and occurs in the mountains to the east above the plains of Qum, Kashan, and Ardishtan, as well as in the Enarek Massif.

3. *Sitta n. plumbea* Koelz, 1950 (type locality, Guragan, southern Kirman). This recently described race (Amer. Mus. Novitates, no. 1452, p. 9) has the facial stripe poorly developed as in *tschitscherini*, but differs at once from this race, as well as from all other known populations of the species, in the ashy coloration of the throat and breast; above, it is dark like *rupicola* but duller. It is apparently restricted to the mountains of southern Kirman.

There are three other described races of *S. neumayer*: nominate *neumayer* Michahelles, 1830, type locality, Ragusa, Dalmatia; *syriaca* Temminck, 1835, type locality, Syria and Levant; and *zarudnyi* Buturlin, 1907, type locality, Aidin, Asia Minor. The three Iranian races differ from topotypical specimens of nominate *neumayer* and *zarudnyi* as follows: *tschitscherini* and *plumbea* in the poorly developed facial stripe, the very pale coloration of the former and the ashy throat and breast of the latter. *Sitta n. rupicola* is closer to nominate *neumayer* and *zarudnyi* but is smaller than the former, with a shorter and thinner bill, and is paler above and below; is paler than the latter, bluer above, less rusty below, and its bill, though of the same size, is slightly thinner. I lack specimens of *syriaca*, but the validity of this form said to be "somewhat paler" than nominate *neumayer* is questioned by Hartert.

GEOGRAPHICAL VARIATION

Geographical variation involves size, principally that of the bill, and coloration.

The variation in size is subtle. The measurements given in table 4 show that the wing length in Iran is very similar, *plumbea* being very slightly smaller. Figure 3 suggests that the bill of *plumbea* is also shorter. It may be objected that the sample of this form is insufficient, consisting of only four specimens. How-

ever, since figure 3 also shows that the mean bill length decreases slightly but steadily from west to east (Kermanshah to Kirman), this decrease may be of evolutionary significance.

It is interesting to note that Kirman represents the easternmost population of the species. In the prolongation of the Kirman mountains to the northwest towards Ardistan in central Iran and to the southeast into Persian Baluchistan, *S. neumayer* is replaced by a long and heavy-billed race (*obscura*) of *S. tephronota*. Since these mountains of central and southeastern Iran are considerably drier than the Zagros one can speculate that the changes in the environment no longer permit successful colonization by the weaker-billed species. The peripheral Kirman population appears to be small in numbers, and this, together with the fact that it is also the most isolated of the species, probably accounts for its diverging character, as shown by the striking difference in coloration.

The variation in coloration is more evident. In *tschitscherini*, as in *S. tephronota dresseri*, there is a very gradual cline of decreasing pigmentation from the northwest to the southeast, or from Kermanshah to Niriz and Jahrum in Fars. This is shown by both the coloration of the upper parts and of the abdomen. Although most of the Fars specimens are worn, specimens that are less worn are paler than comparative specimens from Bakhtiari farther west. The cline is slight but quite perceptible.

In *rupicola* the Azerbaijan population, which was collected in the western part of this region, is paler and intermediate in the coloration of the upper parts and abdomen between the populations of *rupicola* from Karaj and Kuh Pansar and the most northern and western population of *tschitscherini* from Kermanshah. However, as the black facial stripe is well developed in the Azerbaijan population it is clearly referable not to *tschitscherini* but to *rupicola*. I would expect that the two forms would intergrade in the region intervening between Saujbulagh and Kermanshah, but unfortunately I have no specimens from this region.

The lone specimen of *rupicola* from the region of Gorgan is like the Karaj population in coloration, but its bill (22.2) is shorter than the mean of *rupicola* (23.7). Gorgan, like Kirman, also represents a terminal population.

There is no evidence of geographical variation in the facial stripe other than subspecific. The stripe is equally well developed in all the populations of *rupicola* and equally reduced in those of

tschitscherini. In *plumbea* it appears to be still more reduced, but this is more apparent than real owing to the lack of contrast between the blackish stripe and ashy throat. For the same reason the breast and throat appear whiter in populations with darker abdomens.

MOULT: The moult and plumages in *S. neumayer* are the same as in *S. tephronota*, and the moult takes place at the same time. Some adults and first winter birds still show a few last traces of moult in the middle of November and early December in Azerbaijan and northern Iran and in one case on a December 25 specimen from Kermanshah as well. In two specimens moulting into first winter plumage on November 15 in Azerbaijan the top pair of rectrices are moulting also. Two juvenal males taken on April 30 at Siachal in Bakhtiari are in the last stages of a complete post-natal moult. Breeding specimens were collected from March 12 to April 8 in Fars.

Sitta tephronota tephronota Sharpe

IRAN: Khorasan: Kotaliyekchinar, August 3-6, 1940, 1 imm. ♂, 1 ad. ♀; Bardu and Bardu Forest, August 16-18, 1 ad. ♂, 1 subad. ♂, 2 ad. ♀; Khaur, September 5-6, 1 ad. ♂, 1 ad. ♀, 1 unsexed subad.

AFGHANISTAN: South of the Hindu Kush: Nozi, June 22, 1937, 2 imm. ♂, 1 ad. ♀; Kandahar, October 18-24, 1 ad. ♂, 1 subad. ♂, 2 ad. ♀. Shibar Pass: November 10, 1939, 2 ad. ♂. North central Afghanistan (north of Hindu Kush): Baligali Pass [Balaghli], August 30, 3 ad. ♂, 2 ad. ♀; Chesmaegawan, September 9, 1 subad. ♂, 1 ad. ♀; Aq Kupruk, September 11, 1 ad. ♂, 1 subad. ♂; Bai, September 19, 1 ad. ♂; Sufak, September 27-28, 2 ad. ♂, 3 ad. ♀; Khami Deh, September 30, 1 ad. ♂. Northeastern Afghanistan: Gumbaz (Kishm), July 7, 1937, 2 ad. ♂; Faizabad, July 15, 2 ad. ♀; Tirgaran, July 19, 1 ad. ♂; Zebak, July 21, 1 subad. ♂, 1 subad. ♀; Iskatul, July 23, 1 ad. ♀.

Sitta tephronota obscura Zarudny and Loudon

IRAN: Region of Karaj: Karaj, February 5, October 30, 1945, 2 ad. ♀. Yezd: Shir Kuh, Dehibala, February 22, 1940, 1 ad. ♀. Kirman: Madenu, December 27, 1939, 1 ad. ♀; Balvard, December 30, 1 ad. ♂; Dehibakri, January 28-29, 1940, 1 ad. ♂, 1 ad. ♀, 1 unsexed ad.; Ushturu Pass, January 30, 1 subad. ♂, 1 ad. ♀; Dehidisk, January 31, 1 ad. ♀; Guragan, February 9-10, 1 ad. ♂, 1 ad. ♀; Maskun, February 11-13, 3 ad. ♂, 1 subad. ♂.

Sitta tephronota dresseri Zarudny and Buturlin

IRAN: Western Azerbaijan: Saujbulagh, December 3, 1940, 2 ad. ♂, 2 ad. ♀. Kermanshah: Kermanshah, December 25-January 13, 1941, 3 ad. ♂, 5 ad. ♀; Qasr i Shirin, January 3-4, 4 ad. ♂, 2 ad. ♀. Luristan: Durud, January 23-25, 1 ad. ♂, 4 ad. ♀, March 1-13, 2 ad. ♂, 1 ad. ♀, May 23-June 7, 1 imm. ♂, 1 imm. ♀, November 12, 1 ad. ♂; Garun, January 29, 1 ad. ♂. Bakhtiari:

Imarat, February 14, 1 ad. ♂; Marbirinji, April 25, 1940, 2 imm. ♂; Labisufed, May 15, 1 ad. ♀. Fars: Jahrum, March 20-22, 3 ad. ♀; Niriz, March 29, 2 ad. ♂, 1 ad. ♀.

***Sitta neumayer rupicola* Blanford**

IRAN: Azerbaijan: Livan, November 15-17, 1940, 1 ad. ♂, 1 subad. ♂, 2 ad. ♀, 1 subad. ♀, 1 unsexed ad.; Saujbulagh, December 4, 1 subad. ♂, 1 ad. ♀; Dashaghi, December 5, 1 ad. ♂, 1 ad. ♀. Mazenderan (region of Gorgan): Shah Kuh, July 16, 1 subad. ♀. Northern Iran, Kondor: Kuh Pansar, October 2-11, 1944, 3 ad. ♂, 1 subad. ♂; Karaj, December 16, 1943, 1 ad. ♂, 1 ad. ♀, December 28, 1944, 1 ad. ♀; March 29, 1945, 1 ad. ♂, December 9, 1 ad. ♂.

***Sitta neumayer tschitscherini* Zarudny**

IRAN: Kermanshah: Kermanshah, December 25, 1940-January 13, 1941, 6 ad. ♂, 4 ad. ♀; Bisitun, January 15, 1 ad. ♂, 1 subad. ♂. Luristan: Durud, January 24-25, 3 ad. ♂, 2 ad. ♀; Garun, January 29-30, 1 ad. ♂, 1 ad. ♀; Beshedalan, June 15, 1 imm. ♀. Bakhtiari: Ti, February 1-13, 3 ad. ♂, 1 ad. ♀, 1 subad. (?) ♀, May 31-June 4, 1940, 2 subad. ♂, 1 imm. ♂, 1 imm. ♀; Imarat, February 15-20, 1941, 7 ad. ♂, 2 ad. ♀, 1 subad. ♀; Siachal, April 30, 1940, 2 imm. ♂; Taze, May 6, 1 ad. ♂. Fars: Persepolis, March 12, 1 ad. ♀; Jahrum, March 20-21, 2 ad. ♂; Niriz, March 29, 2 ad. ♂, 1 ad. ♀; Dastarjin, April 7-8, 2 ad. ♂.

***Sitta neumayer plumbea* Koelz**

IRAN: Kirman: Guragan, February 9, 1940, 1 ad. ♂, February 10, 1 ad. ♂ (the type of *S. n. plumbea*), February 10, 2 ad. ♀.

SUBFAMILY TICHODROMADINAE

***Tichodroma muraria muraria* Linnaeus**

SYNONYM: *Tichodroma muraria longirostra* Gmelin.

IRAN: Azerbaijan: Rezaieh, December 6, 1940, 1 subad. ♂; Khoi, December 10, 1 subad. ♂. Region of Tehran: Karaj, February 4, 1945, 1 ad. ♂. Kermanshah: Kermanshah, December 25, 1940, 1 ad. ♀. Luristan: Durud, January 22, 1941, 2 subad. ♀.

***Tichodroma muraria nepalensis* Bonaparte**

IRAN: Khorasan: Bardu Forest, August 18, 1940, 1 subad. ♂, 1 imm. ♂.

AFGHANISTAN: Southwest: Parah, November 8-9, 1937, 2 ad. ♂. Western: Herat, November 12, 1 ad. ♀; Maimana, November 18-19, 2 ad. ♂; Safedsang, September 21-25, 1939, 1 subad. ♂, 2 subad. ♀; Khami Deh, September 29, 1 ad. ♂; Burchao Pass, October 10-12, 1 ad. ♂, 1 ad. ♀, 1 subad. ♀. North central: Balkh, November 27-30, 1937, 1 ad. ♂, 2 ad. ♀, 1 ad. [♀]; Binimang, September 1, 1939, 1 ad. ♂; Pul i Khumri, November 7, 1 ad. ♂.

INDIA: Kashmir, Ladak: Tog Nulla, August 18, 1931, 1 imm. ♂, 1 imm. ♀; Leh, September 16, 1936, 1 ad. ♀. Kashmir, Zaskar: Reru, September 18,

1931, 1 subad. ♀; Char, September 28, 1 subad. ♀. Kashmir, Baltistan: Tale Valley, August 23, 1 ad. ♂; Karzong, September 12, 1936, 1 subad. ♂. Northern Punjab, Kulu: Kulu, November 3-5, 1936, 2 ad. ♂; Shim, November 18, 1948, 1 subad. ♀. Northern Punjab, Kangra: Kotla, January 8, 1 ad. ♂. Kumaon: Rilkot, June 13, 1 ad. ♀.

Stresemann (1937, Jour. Ornith., vol. 85, p. 511) has stated that the eastern populations of the Wall Creeper from western Tibet and Sikkim to Kansu are long winged and short billed, while those of Europe are short winged and long billed. The populations from Tian Shan to the Caucasus, he states, are unusually variable, but may perhaps, as a long-winged and long-billed race (*longirostra* Gmelin, type locality, "mountains of Persia"), be separable from the European populations. Meinertzhagen, however, comments (1938, Ibis, p. 671) that in large series the measurements may overlap "to such an extent that recognition of races can serve no useful purpose," though the trends may be confirmed. Since the specimens collected by Koelz and those in the collection of the American Museum of Natural History represent every part of the range and form a sizable series (88 specimens), this opportunity to review the question has been taken.

This material shows that the species is easily separable into two forms: a paler and shorter-winged race (nominate *muraria*, type locality, southern Europe) for the populations from Europe to the Caucasus and northern and western Iran; and a darker, longer-winged race (*nepalensis* Bonaparte, type locality, central Asia) for the populations from Khorasan eastward. As stated by Kipp (1928, Anz. Ornith. Gesellsch. Bayern, p. 129), the eastern populations also have larger white apical spots on the outer rectrices and a tendency to have the base of the tail feathers pinkish.

It is impossible to recognize a third race. Specimens from the Caucasus and northern and western Iran are not separable in either coloration or size from European specimens of nominate *muraria*, while those from Transcaspia, Khorasan, and western Afghanistan are larger and have the same coloration as the populations from farther east. Since Gmelin apparently never reached into this region but did travel in Gilan and Mazenderan (Stresemann, 1928, Jour. Ornith., vol. 76, p. 314), I consider *longirostra* to be a synonym of nominate *muraria*.

The differences in coloration have been ignored or have not received sufficient attention. Greschik (1929, Kócsag, vol. 2, p. 29) mentioned that a specimen east of Ferghana was darker, and

Schäfer (1938, Proc. Acad. Nat. Sci. Philadelphia, vol. 90, p. 214) supported Kipp, adding that he found "that the apex of the outer tail feathers is much wider (9.5–12) mm in Asiatic specimens, as against only 7–10 in European representatives." I find, however, that I cannot confirm this last, so-called character. Schäfer does not give the number of specimens examined. The width in my specimens, in which the tip of the feather is not too badly worn or disarranged, is given in table 6. This table also shows that the presence or absence of pink on the base of the tail feathers is too variable.

TABLE 6

VARIATIONS IN *Tichodroma muraria* IN THE PRESENCE OR ABSENCE OF PINK AT THE BASE OF THE TAIL FEATHERS AND IN THE WIDTH OF THE WHITE APICAL SPOT OF THE OUTER RECTRICES

Region	Pink Present	Pink Absent	N	Width of Apical Spot
S. Europe	2	7	9	9–12 (10 1)
Caucasus	0	3	3	9, 10, 10
N. and W. Iran	1	5	4	9–10 (9 3)
Transcaucasia, Khorasan, and Afghanistan	16	7	18	8–12 (10 0)
Himalayas	14	12	22	8–12 (9.9)
Turkestan	3	8	11	8–12 (9.8)
China	8	2	8	9–11 (9.8)

The only two color characters that can, despite a slight amount of individual variation, be reliably used for separating nominate *muraria* from *nepalensis* are the larger white apical spots of the latter and its darker coloration. This last is not striking, but in series, specimens in comparative plumage are, sex for sex, consistently and distinctly paler above and below (on the head, mantle, and from the breast down) in the western populations of southern Europe and northern and western Iran. In the darker eastern populations from Transcaspia and Khorasan eastward the darkest are those of Sikkim and China (Kansu, Szechwan, Shensi, and Hopeh).

As figure 4 shows, the mean wing length in the eastern populations gradually increases as the populations go eastward. There is a certain amount of overlap, but the trend is well marked. For instance, in 18 specimens of nominate *muraria* the mean wing length (98.5) is below the smallest measurement (99) in 14 speci-

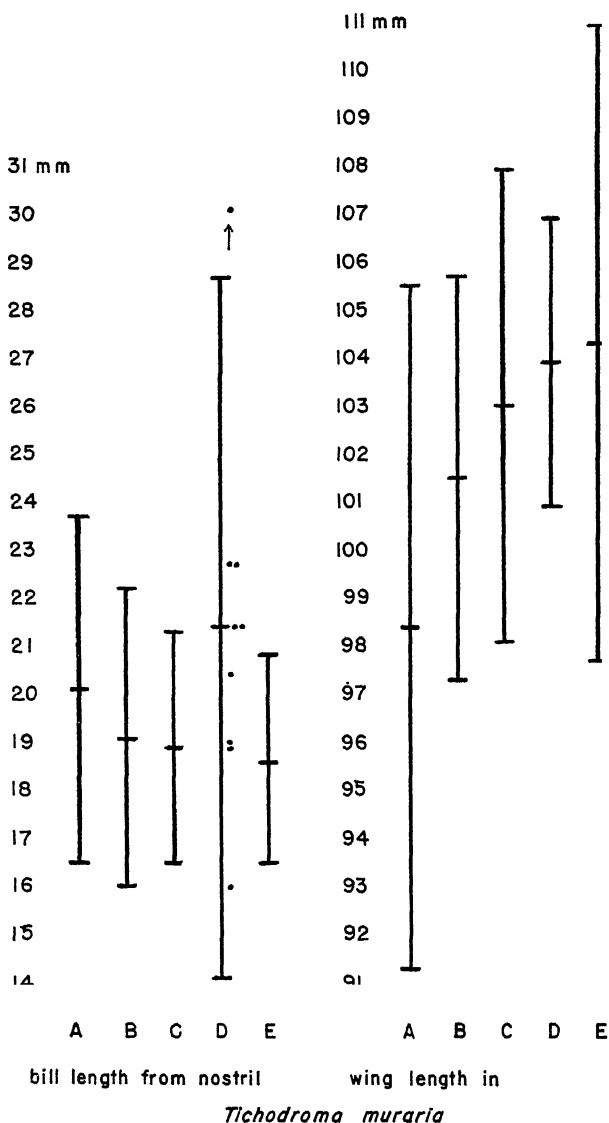


FIG. 4. Variations in bill and wing lengths in *Tichodroma muraria*: A, Europe to western and northern Iran; B, Khorasan, Ashkhabad, and Afghanistan; C, Kashmir and northern Punjab; D, Russian Turkestan; E, Sikkim and China. In D, where the sample may be insufficient, individual measurements are also indicated. Horizontal markings represent the mean and two standard deviations above and below.

mens of *nepalensis* from Sikkim and China. Taken in combination with the differences in coloration, the size difference appears to be of taxonomic significance. As this figure also shows, the overlap in bill measurements is virtually complete and the means are similar, except in population D from Russian Turkestan. In this population, where individual measurements are indicated, the number of measurements may be insufficient, or, as noted by Stresemann, the bill length may be unusually variable. The extraordinary bill length of one of the specimens may be noticed; in this specimen, a male, the full bill length is 42 mm.

The individual measurements are given below. Capital letters refer to the populations in the graph. The bill was measured from the skull with a pair of dividers. It was also measured from the nostril, in tenths of a millimeter, with a caliper, the point of the instrument being inserted through the nostrils and pulled forward firmly against their anterior border. As this last measurement is the more accurate it was used in the graph. Since adults and first winter birds seem to have similar measurements, and in any case cannot always be distinguished, the measurements of all the specimens are used, except of course those obviously juvenal.

Tichodroma muraria muraria

A. Southern Europe: Wing: males, 99, 99, 99, 102, 102; females, 96, 98, 99; unsexed, 96. Bill from skull: males, 30, 30, 30.5, 31.5, 34; females, 30, 30.5, 33.5; unsexed, 37. Bill from nostril: males, 17.2, 18.9, 19.4, 21.5, 21.6; females, 19.6, 19.7, 22.5; unsexed, 25.3. Caucasus: Wing: males, 94, 98, 99. Bill from skull: males, 29, 32, 32. Bill from nostril: males, 19.2, 20, 21.1. Northern and western Iran: Wing: males, 96, 101, 101; females, 94, 95, 101. Bill from skull: males, 31, 32, 32; females, 32, 33, 34. Bill from nostril: males, 20, 20.2, 20.4; females, 22, 22.2, 23.4.

Tichodroma muraria nepalensis

B. Ashkhabad: Wing: male, 101; unsexed, 102. Bill from skull: male, 29.5; unsexed, 29. Bill from nostril: male, 16.5; unsexed, 16.7. Khorasan: Wing: males, 101, 103. Bill from skull: males, 28, 29. Bill from nostril: males, 17.3, 18.4. Western and north central Afghanistan: Wing: males, 99, 100, 101, 102, 103, 103, 104, 104, 104; females, 98, 99, 99, 99, 100, 101, 105. Bill from skull: males, 29.5, 30, 30, 30.5, 30.5, 31, 31, 31.2, 31.5, 32; females, 28, 29.5, 30.5, 31.5, 31.5, 32, 32.5, 34. Bill from nostril: males, 17.4, 17.7, 17.9, 18, 18.4, 18.8, 19, 20.4, 20.6, 21; females, 18, 19.4, 19.5, 19.6, 20, 20, 20.8, 22.7.

C. Kashmir: Wing: males, 102, 103, 106, 106; females, 99, 99. Bill from skull: males, 27, 28.5, 30, 32; female, 29. Bill from nostril: males, 16.3, 17.9, 18, 21.1; female, 18.4. Northern Punjab (9), Kangra (1), Kumaon (1): Wing: males, 101, 103, 103, 104, 105, 105, 106, 106, 106; females, 100, 101. Bill from

skull: males, 29.5, 30, 30.5, 30.5, 30.5, 31.5, 31.5, 32, 33; females, 30.5, 31.5. Bill from nostril: males, 17.9, 18, 18.9, 19.1, 19.4, 19.5, 20, 20.2, 20.7; females, 18.4, 20.

D. Russian Turkestan: Tashkent: Male, respectively, 102, 31.5, 20.5. Ferghana: Wing: males, 105, 106; female, 104; unsexed, 103. Bill from skull: male, 30.5; female, 29; unsexed, 31. Bill from nostril: male, 19; female, 16.1; unsexed, 19.1. Djarkent, all males: Wing: 102, 102, 104, 105, 106. Bill from skull: 33, 33, 35, 35, 42. Bill from nostril: 21.5, 21.5, 22.8, 22.8, 30.2.

E. Sikkim: Wing: male, 108; unsexed, 99, 104, 104. Bill from skull: male, 32.5; unsexed, 29, 29, 32.5. Bill from nostril: male, 18.9; unsexed, 17.6, 18.4, 20.2. China: Northern Kansu: Female, respectively, 101, 29, 18.1. Szechwan: Wing: males, 105, 111; unsexed, 105. Bill from skull: males, 30, 30; unsexed, 29. Bill from nostril: males, 18.6, 19.1; unsexed, 17.7. Shensi (southern): Wing: males, 103, 104, 105; female, 100. Bill from skull: males, 28.5, 29; female, 29. Bill from nostril: males, 17.8, 18.7; female, 17.8. Northern Hopeh: Male, respectively, 106, 33, 21.2. Western China (no locality): Unsexed, respectively, 110, 29.5, 19.8.

MOULT: Adults have a double moult, a complete postnuptial moult, and a partial prenuptial moult which involves only the replacement of the feathers of the head, throat, neck, and some feathers of the mantle, the forehead and crown becoming gray and the lores, chin, and throat black. The complete moult is almost over in specimens taken on August 23 in Kashmir, September 1 in north central Afghanistan, and September 6 in Sikkim. The partial moult is just starting on a specimen taken on February 4 at Karaj in northern Iran, is more advanced on specimens taken on February 27-28 at Djarkent, and is almost over on specimens taken on March 4 and 14 at Ashkhabad.

Juvenals moult into first winter plumage through a partial postjuvenile moult which involves the replacement of the body feathers, lesser, and middle (?) upper wing coverts. This moult is just starting or well advanced on specimens taken on August 18 in Khorasan and is ending on specimens taken from September 16 to 28 in northwestern Afghanistan and Ladak. Specimens in first winter plumage are like adults except that usually the white of the throat feathers is not quite so pure. In fall and early winter their wing quills are browner and more worn than those of the adults which are blacker and fresher. Whether or not first winter birds go through the partial spring moult of the adult I cannot tell. All my spring specimens are either moulting or in breeding plumage, and, through the palpation of the skull, appear to be fully adult.

CERTHIIDAE

Certhia familiaris persica Zarudny and Loudon

IRAN: Mazenderan (region of Gurgan): Dimalu, July 23, 1940, 2 imm. ♂, 1 imm. ♀; Kherat, July 24, 1 imm. ♂.

Stresemann (1928, Jour. Ornith., vol. 76, p. 364) states that this race is extremely similar in coloration to nominate *familiaris* but differs in its much longer bill. I lack immature specimens of nominate *familiaris* and adults of *persica*. In my three immature specimens of the latter with a complete bill, the bill measures 18.5 in two males, and 16 in the female. In adult nominate *familiaris* the "Handbook of British birds" (1938, vol. 1, p. 238) gives the bill length from the skull as 14–16 in 12 males, and 13–16 in an unspecified number of females.

Certhia familiaris hodgsoni Brooks

INDIA: Northern Punjab, Lahul: Tsokang Nulla, October 19, 1936, 2 ad. ♂, 2 ad. ♀; Muling, October 24, 1 ad. ♀.

Only one specimen from an unspecified locality in Kashmir is available for comparison. The Lahul specimens match it in coloration and measurements. Wing: Kashmir, unsexed adult, 67; Lahul, males, 66, 70; females, 63, 63.5, 63.5. Tail: Kashmir, 62; Lahul, males, 60, 65; females, 57+, 59, 60. Bill: Kashmir, 17.5; Lahul, males, 19, 21; females, 17, 17.5.

Certhia familiaris mandellii Brooks

INDIA: Tehri: Chitona, September 28, 1948, 1 subad. ♀; Bhujeka, October 12, 1 ad. ♂. Kumaon: Sundum, July 4, 1 imm. ♀.

These specimens, and an adult male in the collection of the American Museum of Natural History taken on October 4, 1930, at Nandukital in Kulu, are similar to specimens of *mandellii* from Sikkim, but average perhaps slightly paler and duller. Stuart Baker (1922, Fauna of British India, vol. 1, p. 434) gives the distribution of *hodgsoni* as "Garhwal to North-West Kashmir." However, if my specimens from Tehri and Kulu are not fall migrants, the range of the unmistakably darker and more richly colored *mandellii* apparently extends farther west, the two races replacing each other in northern Punjab, *mandellii* to the south in Kulu, and *hodgsoni* to the north in Lahul.

MEASUREMENTS: Kulu: Adult male, wing, 63; tail, 58; bill,

16. Tehri: Wing: adult male, 71; subadult female, 65. Tail: male, 63; female, 60. Bill: male, 18.5; female, 17. Sikkim: Unsexed adults, wing, 64, 67, 68.5, 69, 69, 69.5, 71; tail, 60, 60, 61, 62, 65, 66, 67; bill, 16, 16.5, 17, 17, 17.2, 17.5, 18; unsexed subadult, wing, 70; tail, 62; bill, 17.

CERTHIA HIMALAYANA

The specimens collected by Koelz and those in the collection of the American Museum of Natural History support Meinertzhagen's division of this species (1922, Bull. Brit. Ornith. Club, vol. 42, pp. 140-141) into three races: *C. h. taeniura* Severtzow, 1873 (type locality, Turkestan), *C. h. limes* Meinertzhagen, 1922 (type locality, Gilgit), and *C. h. himalayana* Vigors, 1831 (type locality, Garhwal or Kumaon, according to Meinertzhagen). On the basis of the material available so far, Koelz' *cedricola* from eastern Afghanistan (1939, Proc. Biol. Soc. Washington, vol. 52, p. 65; type locality, Jalalabad) appears to be a synonym of *limes*.

The three races differ in their degree of saturation. In my specimens, those from western Afghanistan, which are identical with specimens of *taeniura* from Samarkand and Ferghana, are distinctly paler and grayer above and below than specimens from eastern Afghanistan and Gilgit eastward to Kumaon. In the latter, I lack sufficient specimens from Gilgit and Kashmir (*limes*), but specimens from Chamba eastward (nominate *himalayana*) differ from specimens from eastern Afghanistan, Gilgit, and Kashmir by being less "smoky," brighter and buffy below, and, above, by being darker and more rufous as they go eastward. But this cline in the increased pigmentation of the upper parts is slight, and the more western specimens in nominate *himalayana* are hardly separable from *limes*. On the other hand the difference between these two races and *taeniura* is clear cut and is supported by a difference in the length of the bill which is longer in *taeniura* (see measurements below).

The breeding specimens collected by Koelz in eastern Afghanistan are a little paler and grayer than the specimens I have from Gilgit and Kashmir, but the latter are too few, and the Koelz specimens collected on June 3 to 19 are too badly worn. In view of the decrease of pigmentation from east to west, it is possible that adequate breeding specimens will show the population of eastern Afghanistan to be distinct enough to warrant separation.

Whistler (1944, Jour. Bombay Nat. Hist. Soc., vol. 44, p. 518) questions Baker's statement (1922, Fauna of British India, vol. 1, p. 431) that *taeniura* occurs in Afghanistan. However, as stated above, the specimens collected by Koelz in western Afghanistan are identical with others from Samarkand and Ferghana. To base, as Whistler does, the identification of *taeniura* on the bill length is to overlook the obvious, this race being so much paler. Further, it is misleading, for, as my measurements show, Turkestan birds can also have short bills, while long-billed birds occasionally occur in *limes* and nominate *himalayana*.

MOULT: Adults have a complete postnuptial moult which probably starts at the end of June or early July, to end in early September. Specimens taken on June 17 to 19 in eastern Afghanistan, June 26 in Lahul, and July 4 in Chamba, although extremely worn, show no signs of moult, but on July 20–August 4 specimens from Kumaon this moult is far advanced. In two adults from Baltistan, taken on August 19 to 20, one is in the midst of the moult, while it is almost over in the other. Juvenals moult into first winter plumage through a partial postjuvinal moult involving only the replacement of the body feathers, lesser and middle upper wing coverts. This moult probably takes place at the same time as the complete moult of the adult, but in my specimens, while adults no longer show signs of moult by the middle of October, first winter birds from the same regions still show traces of moult from October 9 to 20 in Lahul and October 30 in Kumaon. However, this moult is completely over in first winter specimens taken on September 21 and October 14 in western Afghanistan.

The following measurements are of adults only:

Certhia himalayana taeniura

Western Afghanistan: Males, wing, 72.5, 73; tail, 69, 70; bill, 24.5, 26. Samarkand: Male, wing, 74; tail, 68; bill, 26. Ferghana: Wing: males, 72.5, 73, 73; females, 69+, 70; unsexed, 70. Tail: males, 63, 68, 68; females, 59+, 62+; unsexed, 63+. Bill: males, 24, 25, 26; females, 22, 26; unsexed, 22.

Certhia himalayana limes

Eastern Afghanistan: Wing: males, 69+, 71, 71.5+, 72+; females, 66, 67, 67+, 68+; unsexed, 68, 71.5. Tail: males, 56+, 57+, 67, 67+; females, 57+, 58, 62, 62+; unsexed, 61+, 65. Bill: males, 22.3, 22.5, 24; females, 19.5, 19.5, 20.5, 21.5; unsexed, 20, 22. Baltistan: Wing and tail moulting; bill, male, 22. Gilgit: Females, wing, 68, 71.5; tail, 63+; bill, 20, 25.

Certhia himalayana himalayana

Chamba: Males, wing, 71.5+, 73+; tail, 60+; bill, 22. Lahul and Kulu: Wing: males, 68, 69.5, 72, 73, 73.5, 75; females, 67, 68+, 69, 71. Tail: males, 59+, 61+, 66, 67, 68, 68+, 70; females, 61, 61+, 66+, 66+. Bill: males, 21, 22, 22, 22.5, 22.5, 23, 23.5; females, 19, 20.2, 20.5, 23.2. Simla and Rampur: Wing: males, 72, 73; females, 68, 69, 70, 71; unsexed, 67, 67, 70, 72.5. Tail: males, 64, 68; females, 58+, 61+, 67, 68; unsexed, 62+, 63, 65, 68. Bill: males, 23.5, 24.5; females, 21, 22; unsexed, 20, 21, 22, 22. Kumaon: Males, wing and tail moulting in two; in one, wing, 72, tail, 72; bill, 22, 22.3, 24.

Certhia himalayana taeniura Severtzow

AFGHANISTAN: North central: Terak, September 5, 1939, 1 subad. ♀. Northwestern: Safedsang, September 21, 1 subad. ♂; Burchao Pass, October 12-14, 2 ad. ♂, 1 subad. ♀.

Certhia himalayana limes Meinertzhagen

EASTERN AFGHANISTAN: Kail, June 3, 1937, 1 ad. ♂; Farajghan Pass, June 6, 1 ad. ♂; Sirotai, June 17-19, 1 ad. ♂, 2 ad. ♀; Jalalabad, December 18, 1 ad. ♀ (the type of *C. h. cedricola*), December 18-19, 1 ad. ♂, 1 ad. ♀, 2 unsexed ad.

INDIA: Kashmir: Tragbal, August 1, 1936, 1 imm. ♂, 1 imm. ♀. Kashmir, Baltistan: Shigar, August 19-20, 2 ad. ♂.

Certhia himalayana himalayana Vigors

INDIA: Chamba: Kukti, July 4, 1936, 2 ad. ♂, 1 imm. ♂. Northern Punjab, Lahul: Kyelang, June 26, 1 ad. ♂, October 22, 1 ad. ♂; Tinnu, September 9 1930, 1 subad. ♂; Dartse, October 9, 1936, 1 unsexed subad.; Jalma, October 18, 1 ad. ♂; Tsokang, October 20, 1 subad. ♀; Muling, October 24, 1 ad. ♂; Gundla, October 24, 1 ad. ♀. Northern Punjab, Kulu: Jagatsuk, October 27, 1 ad. ♂; Kulu, November 4-8, 3 ad. ♂; Seobagh Nulla, November 16, 1 ad. ♀. Northern Punjab, Kangra: Kotla, January 5, 1948, 1 ad. ♀; January 26, 1946, 1 subad. ♀. Tehri: Kurihan, September 18, 1948, 1 subad. ♂; Tila, October 2, 1 subad. ♂. Kumaon: Gunji, July 18-20, 1 ad. ♂, 1 imm. ♀; Shankola, July 24, 1 unsexed imm.; Sanandiu, August 4, 1 ad. ♂, 2 subad. ♂, 1 imm. ♂, 1 subad. ♀; Lechiwala, October 30-31, 1 ad. ♂, 1 subad. ♀.

Certhia discolor discolor Blyth

INDIA: Kumaon: Bona, June 28, 1948, 1 imm. ♂. Nepal: Chitlang, April 23, 1947, 1 ad. ♂. Northern Bengal: Darjeeling, December 23, 1936, 1 ad. ♂, 1 ad. ♀.

These specimens extend the range of this form considerably farther west. The specimen from Kumaon is an immature which had probably bred locally, while the specimen from Nepal was actually taken while "breeding." Hitherto the occurrence of this

form as far west as Nepal had been questioned, for according to Kinnear (1937, Ibis, p. 250) the only record for Nepal was based on an unpublished drawing of Hodgson, the depicted specimen probably coming from Sikkim. The Darjeeling specimens of Koelz and others from Sikkim in the collection of the American Museum are darker on the crown than the adult male from Nepal, but the difference may be due to wear, as the Nepal bird is very worn while the plumage is fresh in the others.

MEASUREMENTS: Wing: Nepal, male, 72; Darjeeling, male, 70.5; female, 70. Tail: Nepal, 77+; Darjeeling, male, 77; female, 80. Bill: Nepal, male, 17.5; Darjeeling, male, 17.5; female, 16.

Salpornis spilonotus spilonotus Franklin

INDIA: Surguja: Ramanujanj, October 6-9, 1947, 1 ad. ♂, 3 ad. ♀; November 8, 2 ad. ♂.

No comparative material is available. The population of Rajputana has been separated as *rajputanae* by Meinertzhagen (1926, Bull. Brit. Ornith. Club, vol. 46, p. 83) on the basis of being less heavily marked below and grayer above.

MOULT: The October specimens still show a few last traces of moult in the body plumage.

MEASUREMENTS: Wing: males, 88.5, 90, 90; females, 87, 88, 93. Tail: males, 52, 54, 55; females, 48, 53, 56. Bill: males, 25.5, 26.5, 27.5; females, 26.2, 27, 27.

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A NEW BOWER BIRD (*ARCHBOLDIA*) FROM MOUNT HAGEN, NEW GUINEA

BY ERNST MAYR AND E. THOMAS GILLIARD

In 1940 Dr. A. L. Rand (Amer. Mus. Novitates, no. 1072, pp. 9-10) described a remarkable new species of bower bird from the Snow Mountains of Dutch New Guinea. So distinct was the species that Rand was obliged to erect a new genus for it. The only known eight specimens had been collected by the 1938-1939 Richard Archbold Expedition. The record of one additional specimen from the Wisselmeer was published subsequently (Rand, 1942, Bull. Amer. Mus. Nat. Hist., vol. 79, p. 498).

In 1950, in July, while collecting on Mount Hagen in the Mandated Territory of New Guinea, natives brought the junior author adult males belonging to the genus *Archboldia* which differed drastically from Rand's description of the male of *papuensis*. It was at once obvious that these birds represented either the unknown male of *Archboldia* or a quite distinct, unknown species. Natives also brought in an adult female of the same species which agreed closely with Rand's description of the adult male except for peculiarities to be mentioned below.

Through the courtesy of the Australian authorities the junior author was permitted to bring home four specimens of this remarkable bird ahead of the general collection. We find that these represent an undescribed race of *A. papuensis*.

Archboldia papuensis sanfordi, new subspecies

TYPE: A.M.N.H. No. 348448; adult male; southwestern slope of Mount Hagen, 4 miles west of Tomba, Central Highlands, Mandated Territory of New Guinea; altitude 8500 feet; July 18, 1950; E. T. Gilliard.

DIAGNOSIS: Female much like subadult males and females of *Archboldia papuensis* but tail absolutely and relatively longer (see table 1); body plumage darker, more sooty black, less brown; also less vividly contrasted with dusky scalloping, particularly on the lower back and abdomen; under side of wing and tail feathers blackish, not prominently washed with yellowish olive.

RANGE: Known only from the type locality.

DESCRIPTION: Adult male. Entirely jet black, except crown. Head with a golden crest which, except for a narrow black frontal band, covers the entire crown and extends about 50 mm. beyond. There is a striking difference between the anterior and the posterior part of the crest. On the crown (in front of the eyes) there is an erected crest, the feathers of which are rather broad and decomposed; the upper two-thirds of each feather is pure gold, the base is black (this black base shows as the black forehead). The feathers of the posterior part of the crown (behind the eyes) are narrow, depressed, and on the occiput elongated into a long crest, consisting of feathers up to 57 mm. long. The individual feathers have a golden tip and a broad black base, producing a general effect of gold mottled with black. This black is most conspicuous at the top of the crown where the feathers (and their golden tips) are shortest.

The shafts of the wing quills and tail feathers are black above and yellowish buff below. The base of the primaries is yellow. The plumage is very deep black, almost glossy black on back and scapulars; the under parts are less deeply black, particularly on flanks and crissum.

The tail is deeply forked. Depth of fork, male, 35, 43, 47. Iris Carob Brown (Ridgway); bill black; legs gray.

FEMALE: Upper parts sooty brownish black, faintly more brownish on the head. Individual feathers of the back have faintly darker edges suggestive of the scaled appearance of *A. p. papuensis*, though much weaker. Alula and upper wing coverts like the back; primary coverts chiefly ochraceous with narrow dark brown tips, forming a vivid light patch against the dark wing. In females of *papuensis* the light patch is rather similar to that of *sanfordi*, but it is lighter and inclined to be less extensive. In *sanfordi* the under sides of the primaries have the basal halves of inner vanes pale ochraceous; otherwise they are dark olive black with yellow shafts. The throat is dark brownish black with an olivaceous wash. The concealed portions of the body plumage are dark gray.

TABLE 1
MEASUREMENTS OF *Archboldia papuensis* (IN MILLIMETERS)

	Wing	Tail Feathers		Tail Index	Culmen
		Longest	Shortest		
<i>papuensis</i>					
3 ♂ subadults	155, 155, 162	129.5, 135.5, 147	123, 124, 136	84.5, 87.5, 91	25, 25, 27.5
4 ♀ adults	142, 144, 147, 153.5	126, 130.5	113.5, 123.5	85, 85.5, 87.5	25, 26, 26, 26.5
<i>sanfordi</i>					
3 ♂ adults	163.5, 167, 167	176, 189, 190	143, 143, 146	105, 113.5, 115.5	24.5, 25, 25
1 ♀ adult	146.5	145	138	99	22

REMARKS: A complete report will be issued following study of the Mount Hagen collections. Photographs of the display ground of this rare bird will be published at that time.

Rand's statement (1940, p. 9) that *Archboldia* is related to *Amblyornis* is strengthened by the discovery of the male of *A. papuensis* with its golden crest. Whether or not the nominate race has also a golden-crested, fully adult plumage remains to be discovered. There is no trace of it in any of the three males collected by Rand. However, all three of these birds give an indefinite impression of not being fully adult. Although a golden-crested adult plumage is probable also for nominate *papuensis*, it is worth remembering that in the related genus *Amblyornis* the adult males in one of the four species (*inornatus*) lack the crest.

We take great pleasure in naming this remarkable new bower bird in honor of Dr. Leonard C. Sanford who sponsored the Mount Hagen Expedition and to whose enthusiasm ornithology in general, and the exploration of New Guinea in particular, owe so much.

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STUDIES OF PERUVIAN BIRDS. NO. 58

THE GENERA *CHLOROSTILBON*,
THALURANIA, *HYLOCHARIS*,
AND *CHRSURONIA*

By JOHN T. ZIMMER

I am again indebted to Mr. James Bond and Mr. Rodolphe M. deSchauensee of the Academy of Natural Sciences of Philadelphia, and to Mr. Karl P. Schmidt and Mr. Emmet R. Blake of the Chicago Natural History Museum for the loan of comparative material utilized in the following paper.

Names of colors are capitalized when direct comparison has been made with Ridgway's "Color standards and color nomenclature."

***Chlorostilbon mellisugus phoeopygus* (Tschudi)**

Tr[ochilus] phoeopygus TSCHUDI, 1844 (May), Arch. Naturgesch., 10th year, vol. 1, p. 297—Perú; Chanchamayo Valley suggested by Peters, 1945; Berlin Mus.

Chlorostilbon Daphne GOULD, 1861, An introduction to the Trochilidae, p. 177—Pampas del Sacramento [Perú]; ♂♂ cotypes in British Mus.

Agyrtia media PELZELN, 1868, Zur Ornithologie Brasiliens, pt. 1, pp. 29, 57—Villa Bella de Matto Grosso, Brazil; ♂; Vienna Mus.

The present form is found over most of eastern and central Perú, and most of the Peruvian records are assignable here. They include, in addition to some of the localities from which material has been examined, Huambo, Achamal, Amable Maria, Chirimoto, Chachapoyas, Huiro, and Borgoña.

I have no birds from the Pampas del Sacramento or anywhere on the lower Ucayali from which to establish with certainty the reference of Gould's "*Daphne*" to the present form rather than to

napensis which occurs on the south bank of the Marañón a little below the mouth of the Ucayali. Both birds were described by Gould at the same time and on the same page, with no mention of *phoeopygus*, so it would appear probable that Gould had both forms before him. Furthermore, *napensis* is said to have the blue of the breast somewhat more restricted than it is in "*Daphne*" and the tail shorter than in that form, both of which features agree with the characters distinguishing *napensis* from *phoeopygus*. The assignment of "*Daphne*" to the synonymy of *phoeopygus* is therefore indicated. Taczanowski (1884, Ornithologie du Pérou, vol. 1, p. 415) gives a separate account of "*Chlorostilbon melanorhynchus*," including in the synonymy various references that belong with *phoeopygus*. As far as is known, *melanorhynchus* does not occur in Perú.

Gyldenstolpe (1945, K. Svenska Vetensk. Akad. Handl., vol. 22, no. 3, p. 80) has published a comment (*in litt.*) by Hellmayr to the effect that the type of Pelzel's "*Agyrtia media*" is a young male of the present form. It appears to be the only record of *phoeopygus*, or any form of *mellisugus*, from this part of Brazil. Gyldenstolpe, however, records it furthermore from the upper Rio Juruá and the upper Beni in Bolivia, and Todd (1942, Ann. Carnegie Mus., vol. 29, p. 303) had already assigned two birds from Buena Vista, Santa Cruz, Bolivia, to the same subspecies. I have at hand a young male from the Río Apolobamba, Santa Cruz, and a female from the Province of Sara, Bolivia, that appear to belong here. They certainly are not the following form, *peruanus*, which occurs in northern Bolivia at somewhat higher elevations without any demonstrable overlap in distribution.

In an earlier publication (1930, Field Mus. Nat. Hist., zool. ser., vol. 17, no. 7, p. 275) I cited a reference to the specific name "*daphne*" erroneously credited to Bonaparte. Bonaparte, in turn, credits the name to Bourcier, with no citation except the date, 1854. I am unable to find any mention of the species in any of Bourcier's papers of that, or any, date, and the name in Bonaparte's account is a mere *nomen nudum*. The first valid publication is that by Gould as given above.

There is a slight question concerning the type locality of the oldest name, *phoeopygus*. In the original reference, Tschudi gave no exact locality, but later (1846, Fauna Peruana, Aves, p. 250) he said that the form was found in the coastal region of that country where it was found by Bernhard Philippi; he had not ob-

served the bird himself. Hartert (1900, *Das Tierreich*, no. 9, p. 227) considered Tschudi's bird to have been unrelated to "*Chlorostilbon prasinus daphne*" (under which he had tentatively assigned the reference on p. 77) but possibly a *Metallura*, a conclusion to which he may have been drawn by Tschudi's comparison of *phoeopygus* with "*Orthorhynchus smaragdinus collis*." In spite of Hartert's belief, I think there is little doubt of the identity of *phoeopygus* with the present species. The described characters, including the measurements, are in good agreement, and there is no other Peruvian hummingbird to which they apply equally well. The region assigned to it is certainly erroneous, as is the case with a number of other species described by Tschudi, both from his own and from Philippi's collection.

Taczanowski (1884, *Ornithologie du Pérou*, vol. 1, p. 415) gives a separate account of "*Chlorostilbon melanorhynchus*" in distinction from "*prasinus*," including among the references in the synonymy various citations that belong to *phoeopygus*. He gives no localities, and it is uncertain what basis he may have had for the inclusion of *melanorhynchus* in the Peruvian list for which there is no confirmation. Taczanowski's description agrees well enough with *melanorhynchus* and presumably was drawn up from Ecuadorian examples of that form.

***Chlorostilbon mellisugus napensis* Gould**

Chlorostilbon Napensis GOULD, 1861, An introduction to the Trochilidae, p. 177—banks of River Napo (I suggest Puerto Indiana, northeastern Perú, as restricted type locality); ♂♂ cotypes in British Mus.

Prasitis vitticeps SIMON, 1910, *Rev. Française d'Ornith.*, vol. 1, p. 263—Napo region, Ecuador; ?Paris Mus.

Twenty-three specimens from north of the Marañón, in eastern Ecuador and northeastern Perú, and one from the south bank of that stream east of the Ucayali show certain differences from *phoeopygus* of central Perú that suggest the desirability of recognizing *napensis*. The males are very similar to those of *phoeopygus* but have the belly somewhat more strongly glittering and with a lighter hue, in greater contrast to the bluish color of the throat and breast. In this respect they resemble *subfurcatus* of the Roraima-Duida region of Venezuela, but have the tail less deeply forked. The females have noticeably more extensive green markings on the lateral under parts than in the same sex of the other forms; the green area crosses the entire breast and

upper belly and passes narrowly along the sides of the throat to the base of the bill, leaving the light Smoke Gray throat as a completely encircled patch. I can find no comparable appearance in any of the other forms of the genus, either in the females or the young males.

The possibility that the birds described are young males instead of females as sexed appears untenable. They show none of the usual signs of immaturity but appear to be quite adult. Young males, furthermore, appear to acquire their ventral green coloration first on the median under parts, especially anteriorly, leaving the sides of the throat grayish or sooty even after the whole throat and breast are glittering green or bluish green—quite a different pattern from that exhibited here. The tail in these females also is rounded but not furcate as in even young males (except of *mellisugus mellisugus*). I am further reassured as to the sex of the specimens in question by the account of a female from Andoas, discussed by Berlioz (1937, Bull. Mus. Hist. Nat., Paris, ser. 2, vol. 9, p. 358), evidently like my examples.

One of the young males in the series shows the characters ascribed by Simon to his "*vitticeps*," but the characters are obviously only those of immaturity. The brilliant feathering of the crown has appeared only in the median portion, leaving a broad, dusky brown stripe on either side as the remains of the immature plumage. Similarly, the adult blue-green color of the anterior under parts is in place, but the lower under parts remain sooty, with the central spots of the under tail-coverts bluer (and somewhat duller) than they are in adults; the upper tail-coverts likewise are slightly bluer than the same area in fully developed birds. Perfect transition between this dress and that of adults is shown by other young males in the series. It is obvious that "*vitticeps*" is not a distinct form, even of subspecific rank.

The question of the specific name of the group may well be discussed at this point. Authorities, from very early in the history of hummingbird taxonomy, have been unwilling to adopt the name given by Linnaeus (1758, *Systema naturae*, ed. 10, vol. 1, p. 121) to a small green hummingbird with a black bill and evenly truncate blue tail, a form which he called *Trochilus mellisugus*. The locality given was "*in Indiis*," admittedly inadequate by modern standards but comprehensive enough to cover a wide range of possible places of origin. No synonymy was given except to the Museum Adolphi Friderici (1754). However, a few

years later (1766, *Systema naturae*, ed. 12, vol. 1, pt. 1, p. 192) a number of references were given, particularly those to Edwards (1764, *Gleanings of natural history*, vol. 3, p. 316, pl. 360, fig. 1). Edwards' figure has likewise been discounted by some authors, but his figure shows a small green hummingbird with black bill and evenly truncate, short blue tail, agreeing well with the Linnaean description.

There is only one hummingbird that agrees in these respects with the description of Linnaeus and the figure by Edwards, and that is the Cayenne form of the present species. All other hummingbirds that may agree in one or other of the characters mentioned disagree quite definitely in others. I can see no possibility of associating the name *mellisugus* with any species but this one. Curiously enough, the reference to Edwards appears not to have been questioned by the authors who refused to accept a definite application of the Linnaean citation.

Similarly there has been some question of the application of the name *prasinus* (*Ornismya prasina* Lesson, 1830, *Histoire naturelle des oiseaux-mouches*, p. 188, pl. 65—believed to be from "Brésil"), long associated with the Cayenne bird under discussion. It is true that Gould (1861, *An introduction to the Trochilidae*, p. 176; 1853, *A monograph of the Trochilidae*, [pt. 5], vol. 5, text to pl. 355) misapplied the name to another species, being uncertain as to the precise application, and more recently Berlioz (1949, *Bull. Mus. Hist. Nat.*, Paris, ser. 2, vol. 21, p. 55) has expressed uncertainty as to the identity of Lesson's bird. Here again, however, there is no other species to which Lesson's account can apply and no clear disagreement between the Cayenne birds and the form in question. I have no hesitation in placing *Ornismya prasina* of Lesson as a synonym of *Trochulus mellisugus* of Linnaeus and propose Cayenne as restricted type locality for both birds. *Chlorostilbon brevicaudatus* Gould (1861, *An introduction to the Trochilidae*, p. 178—Cayenne) is a still later synonym, obviously introduced when he adopted *prasinus* for a different species.

A complication of possible significance is involved in the use of the specific name *mellisugus*. The Brissonian genus *Mellisuga* had among its original species the present one under the unavailable name of "*Mellisuga Cayanensis*." Since it possessed the generic name as the correct name of the species in question (although this is not determinable in the original account), the case

might be thought to require the acceptance of "*Mellisuga Cayanensis*" as the type of the genus, by absolute tautonymy, under the provisions of Article 30, I, (d) of the International Code of Zoological Nomenclature. This would necessitate changing the name of both *Chlorostilbon* and the present *Mellisuga* which would be unduly exasperating. Fortunately, Brisson also included among his species of *Mellisuga* one to which he gave the prebinomial name of "*Mellisuga*," and, under the provisions of Opinion 16, this is still acceptable as the type of the genus which leaves the generic nomenclature unchanged. Quite possibly the original intent of the Code was to make available only the "valid" names or synonyms actually cited under the generic name at the time of its original publication, but it does not so state. This provision is in need of rewording by the Commission if the suggested restriction is in order.

Peruvian records of *napensis* are restricted to those from Andoas, Pebas, and Nauta, possibly also "Upper Amazons." It is probable that the cotypes were collected on a portion of the Rio Napo now in Peruvian territory, although this is unascertainable. Gould does not even specify Ecuador in the original account. I have suggested, therefore, Puerto Indiana, mouth of the Río Napo, northeastern Perú, as the restricted type locality.

***Chlorostilbon mellisugus peruanus* Gould**

Chlorostilbon Peruanus GOULD, 1861, An introduction to the Trochilidae, p. 177—Perú; ♂; British Mus.

Chlorostilbon Stubelii A. B. MEYER, Zeitschr. Gesellsch. Ornith., vol. 1, p. 206.

This form was described by Gould ostensibly from Perú, but there is no record of a definite locality in that country. All specimens of exactly known origin have been from northern Bolivia. Nevertheless there is a limited area in extreme southeastern Perú from which the type may have come, and it is unsafe to withdraw the form from the Peruvian list and accept some place in Bolivia as type locality at the present writing. The possible Peruvian region embraces only the general area at the headwaters of the Madre de Dios, Inambari, and Tambopata rivers. If the bird occurs there, it is surprising that it has not been found by one of the various collectors who have visited the region since Gould's time.

I find myself quite unable to appreciate any specific differences in any of the blue-tailed forms of *Chlorostilbon* except those of the

aureo-ventris group. Every character by which different forms can be distinguished from each other shows intergradation either by individual variation or by geographical progression. Extremes at various places may be used to point out rather decided differences from some other extreme, but any attempt to group the forms in recognizable species on such bases must overlook other resemblances of equal significance.

The most important distinctions of the males are those of the color of the bill, the presence or absence of a glittering cap, the intensity of glitter on the lower under parts, the furcation of the tail, and the attenuation of the rectrices. Those of the females are the amount of green on the tail and the development of a sub-basal gray band on at least the outer rectrices. Relative size and, in the males, the blueness or greenness of the breast are certainly also only of subspecific value, often only as an average feature.

An additional character that at first seemed of possible specific significance is the shape of the rectrices, but this proves to be variable at critical places in the geographical sequence of forms. In one group of subspecies, the rectrices are obtuse in outline, and the outermost ones show a somewhat obliquely truncate tip. In the other forms, the outer feathers are more slender and more gradually tapering distally. The first group includes the birds with the least furcation of the tail, and the second, those with the greatest forks, although there is overlap in this respect.

The two divisions approach each other closely in the Santa Marta and Goajira regions of northern Colombia and extreme northwestern Venezuela. Two forms have been recognized in this region by various authors—*chrysogaster* to the westward and *nitens* to the eastward—each assigned to a different specific group by most authors, although Simon considered them as belonging to a single form. From the material at hand, which is not satisfactory in some respects, I am inclined to agree with Simon. The type of *nitens* is indistinguishable from several Santa Martan males except by a slightly shorter fork in the tail and slightly broader outer rectrices. However, there are at hand two additional males from the Lawrence Collection, obtained by Lawrence from W. Galbraith (as was the type of *nitens*), of similar preparation (including the brown fiber used as stuffing), and similarly labeled "Venezuela." These two birds are not different from some of the Santa Martan examples, although there is great

probability that they were collected at or near the same place as the type of "*nitens*." In the Santa Martan series, there is the same amount of variability, although it is at a different place on the scale. None quite matches the type of *nitens*, but some are like the two other Galbraith specimens, and one, together with a male from La Playa, near Barranquilla (virtually topotypical), is at a maximum of depth of fork in the tail and slenderness of the outer rectrices. Except for the characters of the tail, there are no observable differences between *chrysogaster* and "*nitens*." I may add that I have at least one specimen of *gibsoni* that has a tail like that of the type of "*nitens*," although the usual condition in that form is more like that of the intermediate examples from Santa Marta and "Venezuela." Also in *caribaeus* there is a similar amount of variation, although the resemblance there is greater to the type of "*nitens*." I should not be surprised if *nitens* proved to be only a variant of *chrysogaster* but am unable to offer conclusive proof at the moment.

Except for the color of the bill, "*nitens*" closely resembles *caribaeus* which, in turn, approaches *subfurcatus* very closely. I am unable to recognize "*nanus*" from the Orinoco. Although the Orinocan specimens at hand average a trifle smaller than north-coast birds, there is so much overlap that identification of single specimens becomes difficult. There is an average of deeper furcation of the tail in *caribaeus* than in *subfurcatus* and usually less development of blue on the anterior under parts, but extreme examples in the two series show close approximation. General size shows much overlap, especially in the case of the specimens of *subfurcatus* from Roraima and Auyan-tepui. Birds from Duida are rather consistently larger than the Roraima birds, reaching an extreme of size greater than any of the series of *caribaeus*. I hesitate to propose a division of *subfurcatus* on the basis of the slight difference in size (particularly the length of tail), at least until more is learned concerning the distribution on various of the mountains between Roraima and Duida.

The females present a character that shows a certain amount of regularity in its occurrence, but it is not completely regular. The character is that of the markings on the outer rectrices. In the Central American and Mexican forms from *auriceps* down to *salvini*, there is a well-marked gray band near the base of these feathers. It is absent in *assimilis* but occurs rather weakly in *pumilus*, *melanorhynchus*, and *chrysogaster*. It is fully developed

again in *gibsoni*. In the rest of the forms it is rarely suggested, although there is an occasional trace of it.

A series of maps showing the distribution of each of the characters throughout the forms under discussion presents a different pattern for each character and no combination of characters is any more satisfactory. In spite of the wide divergence of extremes, therefore, I believe the best arrangement is that which considers all these forms as conspecific representative subspecies of a very versatile species.

I am puzzled by the distribution of *melanorhynchus* and *pumilus* in western Ecuador and Colombia. The distinction between the two forms is not great, being based on the larger size of *melanorhynchus*, in which feature there is enough overlap to cause confusion. It has been suggested that *melanorhynchus* occurred at higher elevations than *pumilus*, but this is not entirely correct, judging by the material at hand which shows *pumilus* occurring from 200 to 8325 feet, and *melanorhynchus* from 3500 to some 8000 feet. A further disturbing detail is present in five males from the Río Chimbo, Ecuador (virtually topotypical of *pumilus*), that appear to be isolated from the Colombian segment of the population by the occurrence of *melanorhynchus* at Paramba, in the intervening terrain. In any case, the separation of *melanorhynchus* and *pumilus* is far from satisfactory on taxonomic as well as geographical or altitudinal grounds.

SPECIMENS EXAMINED

C. m. auriceps.—

MÉXICO:

(Guerrero, Terra Tepic, and "México"), 2 ♂, 3 [♂], 2 (?♂), 1 ♀, 2 (?♀).

C. m. canivetii. -

MÉXICO:

(Jalapa, Oaxaca, Yucatán, and "México"), 16 ♂, 4 ♀, 1 (?).

GUATEMALA:

(Secanquim and Chanquejelve), 4 ♂, 3 ♀.

C. m. forficatus.—

MÉXICO:

Cozumel Island, 2 ♂, 1 ♀.

C. m. osberti. -

GUATEMALA:

Dueñas, 1 ♂ (cotype);

(Puebla, Finca La Primavera, Finca El Cipres, Finca Sepacuite, San José, Lake Amatitlan, and "Guatemala"), 15 ♂, 3 ♀, 1 "♀" [=♂].

NICARAGUA:

(San Rafael del Norte, Chontales, Matagalpa, Volcán Viejo, Chinandega, Calabasa, and "Nicaragua"), 6 ♂, 2 ♀, 1 (?).

HONDURAS:

(Tegucigalpa, Las Flores, Catacamas, Mt. Pucca, Cantoral, Archaga, Caliche, La Flor, Cerro Nieve, Santa Barbara, Mt. Redondo, and "Honduras"), 39 ♂, 1 "♀" [$? = \sigma^7$], 22 ♀, 1 (?).

C. m. salvini.—

COSTA RICA:

(Escazú, San José, Agua Caliente, Miravalles, La Sabanilla, Las Concovas, Bebedero, and "Costa Rica"), 19 ♂, 1 "♀" [$? = \sigma^7$], 8 ♀, 3 (?).

C. m. assimilis.—

COSTA RICA:

Buenos Aires, 1 ♂, 1 ♀.

PANAMÁ:

(Panamá), 1 ♂ (type);

(Chitrá, El Banco, Boquerón, Bogava, Boquete, La Chorrera, Chiriquí, Veragua, El Villano, Santa Fé, near Corozal, Agua Dulce, Cerro Flores, La Marea, Gamboa, La Colorada, Panamá R. R., [Lion Hill], Jicarón I., Cebaco I., Coiba I., Gobernador I., Pacheco I., Pedro González I., San José I., Palenque I., San Miguel I., Sevilla I., and "Panamá"), 59 ♂, 15 ♀, 2 (?).

C. m. chrysogaster.—

COLOMBIA:

La Playa, 1 ♂;

Bonda, 3 ♂, 1 [♀], 1 (?);

Santa Marta, 2 ♂;

"Venezuela," 2 ♂.

C. m. nitens.—

VENEZUELA: 1 ♂ (type).

C. m. pumilus.—

COLOMBIA:

(Dabeiba, Atuncela, Río Zapata, San Antonio, Barro Blanco, Antioquia, Cali, Caldas, Las Lomitas, Ricaurte, Cerro Munchique, Popayán, Miraflores, La Sierra, Primavera, Cauca Valley, near Medellín, Chicoral, Santa Elena, and "Bogotá"), 30 ♂, 1 "♀" [$? = \sigma^7$], 8 ♀, 1 ? ♀, 4 (?).

ECUADOR:

(Cocó, Chimbo, and Naranjo), 5 ♀.

C. m. melanorhynchus.—

ECUADOR:

(Pichincha, Valley of Cumbaya, Tumbaco, Ibarra, Quito, Lake Taguara-cocha, Chota, Paramba, "Río Napo," "Panamá," and "Trinidad"), 37 ♂, 10 ♀.

C. m. gibsoni.—

COLOMBIA:

(Sasaima, Río Toché, Chicoral, El Carmen, within 20 miles of Honda, west of Cúcuta, near San Agustín, "Bogotá," and "Venezuela"), 79 ♂, 15 ♀.

NO LOCALITY: 1 ♂.

C. m. caribaeus.—

VENEZUELA:

Caicara, 5 ♂ (including type of *nanus*), 2 ♀;

(Plain of Cumaná, San Félix, Tucacas, La Tigrera, Caracas, La Florida, Las Trincheras, El Cuji, Barquismeto, Altigracia, San Fernando de Apure, Puerto Zamuro, Quiribana de Caicara, Las Barrancas, Sacupana, Ciudad Bolívar, Perico, Ayacucho, and Orinoco River), 39 ♂, 8 ♀.

CURACAO: 7 ♂ (including type), 2 ♀.

BONAIRE: 2 ♂.

MARGARITA: 1 ♂.

ARUBA: 3 ♂.

TRINIDAD:

(Tacarigua, Laventille, and Pointe Gourde), 10 ♂, 1 ♀.

C. m. mellisugus.—

CAYENNE:

Roche Marie, 1 ♂;

Cayenne, 13 ♂, 4 ♀;

"Cayenne" [trade skins], 6 ♂, 1 ♀.

SURINAM:

Near Paramaribo, 2 ♂.

NO LOCALITY: 1 [♂].

C. m. subfurcatus.—

BRITISH GUIANA:

Wisimar, 1 ♀.

VENEZUELA:

Mt. Roraima, 8 ♂, 3 ♀;

Philipp Camp, Roraima, 3 ♀;

Arabupu, 4 ♂, 4 ♀;

Mt. Auyan-tepui, 1 ♂, 2 (?);

Mt. Diuida (Cerros de Savanna and Laterite Valley), 17 ♂, 4 ♀, 1 (?).

C. m. napensis.—

ECUADOR:

(Río Suro above Avila, below San José, and Gualaquiza), 6 ♂, 1 [♀].

ECUADOR OR PERÚ:

Napo, 8 ♂.

PERÚ:

Pebas, 1 ♂;

Puerto Indiana, 3 ♂, 1 ♀;

Orosa, 1 ♀.

NO LOCALITY: 1 ♂.

C. m. phaeopygus.

PERÚ:

Río Seco, west of Moyobamba, 3 ♂;

Perené, 1 ♂;

Utcuyacu, 1 ♂;

La Merced, 1 ♂;

Chanchamayo, 1 ♂¹;

Huánuco, 3 ♂¹, 1 ♀¹;

Chinchao, 3 ♂¹;

Vista Alegre, 1 ♂¹;

Specimens in Chicago Natural History Museum.

Río Cayumba, 1 ♂¹;
 San Miguel Bridge, 2 ♂;
 San Miguel, 1 ♂;
 Santa Ana, 4 ♂, 2 ♀, 1 (?);
 "Perú," 1 [♂].

C. m. peruanus.—

BOLIVIA:

(Yungas, Mapiri, Suapi, Omeja, Chaco, Río Apolobamba, and Prov. Sara).
 7 ♂, 3 ♀.

[*Chlorostilbon poortmani euchloris* (Reichenbach)]

Chlorestes Euchloris REICHENBACH, 1854, Jour. f. Ornith., vol. 1, Extraheft, Beilage, p. 23—"Nord-Peru" [*errore* = Colombia]; ♂; Halberstadt Mus.

Although Reichenbach specifically claims the type to have been collected in northern Perú by Warszewicz, and the specimen was evidently so labeled since the claim is maintained by Cabanis and Heine and later by Ferdinand Heine, there is no supporting evidence of the occurrence of any of the green-tailed forms of the genus *Chlorostilbon* in that country.

The presumably correct assignment of the name to one of the Colombian forms is difficult to trace. Gould (1861, An introduction to the Trochilidae, p. 180) tentatively suggested "New Granada" on the basis of a second specimen in the Berlin Museum which was without certain locality, and in later accounts he omitted the query. Mulsant and Verreaux (1875, Histoire naturelle des oiseaux-mouches, vol. 2, p. 117) discuss the name under the allied form, *alice*, and Elliot (1878, Smithsonian Contrib. to Knowledge, no. 317, p. 248) places it in the synonymy of that form. Berlepsch (1887, Jour. f. Ornith., vol. 35, p. 336) appears to be the first author to establish the identity of *euchloris* with any certainty when he compared the type with his "*Panychlora poortmani major*" (1884, Jour. f. Ornith., vol. 32, p. 313—Bucaramanga, Colombia) and found them identical.

I have considerable doubts of the validity of *euchloris* in distinction from *poortmani*. I have seen very few specimens with definite localities, but over 60 Bogotá trade-skins are impossible to segregate into two satisfactory forms on the basis of either size or coloration. Furthermore, some authors who have recognized both forms have found *poortmani* on both sides of the Eastern Andes to which *euchloris* appears to be restricted. Without adequate series of localized specimens, however, I am unable to establish either the identity or distinction.]

¹ Specimen in Chicago Natural History Museum.

[*Chlorostilbon auratus* (Cabanis and Heine)

Panychlora aurata CABANIS AND HEINE, 1860, Museum Heineanum, pt. 3, p. 50—Perú; ♂♂ cotypes in Halberstadt Mus.

This supposed form, resurrected by Simon (1921, *Histoire naturelle des Trochilidae*, pp. 60, 289), although with a query, is in much the same situation as *euchloris*. I can find no critical review of the cotypes, although Berlepsch (1887, *Jour. f. Ornith.*, vol. 35, p. 334) places the name tentatively in the synonymy of *poortmani* where I suspect it belongs. The Peruvian origin of the cotypes is extremely doubtful.]

Thalurania furcata viridipectus Gould

Thalurania viridipectus GOULD, 1848, *Proc. Zool. Soc. London*, pt. 16, p. 13—Columbian Andes; I suggest Buena Vista. above Villavicencio; ?British Mus.
Thalurania tschudii "Gould MS." SCLATER, "1858" [1859], *Proc. Zool. Soc. London*, pt. 26, p. 460—Gualaquiza and Zamora, Ecuador; ?British Mus.

A series of birds from the region of the Rio Negro, northern Brazil, the type region of Gould's *nigrofasciata*, shows certain fairly definite differences from the east-Ecuadorian, east-Colombian, and north-Peruvian population and suggests the advisability of recognizing an additional form, for which the name *viridipectus* is presumably available. The Rio Negro birds are more golden green, less bluish green, on the back, with a more obvious blackish band across the upper mantle as seen in certain lights and with the entire back becoming rather uniformly sooty in certain positions. The top of the head is more frequently coppery, although this feature is more variable than the color of the back which is observable in females as well as males. The green gorget of the males averages lighter in tone than in the Ecuadorian birds and their near neighbors, and the black necklace bordering the gorget is somewhat more broadly developed in many cases. The females, as mentioned, have the back more golden and less bluish green than those of *viridipectus*, and the same difference of color is noted on the median rectrices where, in addition, the greenish hue is more frequently carried to the tips instead of being succeeded by a slaty blue terminal area.

It is unfortunate that the name *viridipectus* appears to have been based on a bird which lacked the black necklace, but Gould later (1861, *An introduction to the Trochilidae*, p. 78; 1861, *A monograph of the Trochilidae*, [pt. 21], vol. 2, text to pl. 104) con-

sidered it to be the same as "*nigrofasciata*," and no evidence has been presented to identify it with one of the forms that never has the black necklace. A young male from "Bogotá" shows no black in the area but is still in undeveloped plumage as, perhaps, Gould's bird may have been. The original description notes the abdomen as "bright blue" which again suggests an immature example. No specimen is recorded in the "Catalogue of birds in the British Museum" as type of *viridipectus*, so the matter is difficult to decide otherwise than by accepting the conclusion of the author of the name. If *viridipectus* should prove untenable in this connection, *tschudii* is available for this form.

It is curious that Salvin and Elliot (1873, Ibis, ser. 3, vol. 3, p. 357) should have stated that Gould described *nigrofasciata* from specimens secured in Ecuador. Gould clearly notes the locality of origin as Rio Negro, Brazil.

I have no hesitation, therefore, in recognizing this form, which at present I call *viridipectus*, as a distinct subspecies. It ranges from the eastern side of the Andes near Bogotá, Colombia, southward to the Marañón and even crosses the Marañón in northern Perú to the neighborhood of Moyobamba. Birds from Moyobamba have hitherto been referred to another subspecies that will be discussed under *jelskii*, and it is true that birds from that area sometimes show a trend toward the characters of that form, but of 10 males from the Moyobamba region, six are indistinguishable from *viridipectus*, and the other four are varyingly intermediate. A male from Chayavitas also presents the characters of *viridipectus*. Until a larger series from that region is available that might point to other conclusions, I must refer the Moyobamba series to *viridipectus*.

Records that will go with this subspecies are presumably those from Yurimaguas and Jeberos, in close proximity to Chayavitas, as well as some of the localities from which material has been examined in the present study.

***Thalurania furcata jelskii* Taczanowski**

Thalurania tschudii GOULD, 1860 (not Sclater, 1859), Proc. Zool. Soc. London, pt. 28, p. 312—neighborhood of the River Ucayali; cotypes in British Mus.

Thalurania jelskii TACZANOWSKI, 1874, Proc. Zool. Soc. London, p. 138—Soriano, Perú; ♂; formerly Warsaw Mus., now lost.

Thalurania taczanowskii DUNAJEWSKI, 1938, Acta Ornith., Mus. Zool. Polonici, vol. 2, no. 15, p. 322—Achamal, Río Huambo, Perú; ♂; Warsaw Mus.

I am somewhat hesitant in recognizing this population as a valid subspecies since it is, at best, strictly intermediate between *viridipectus* and *boliviana* and varies in different parts of its range according to the proximity of one form or another. It must be admitted that in the neighborhood of the type locality of "*taczanowskii*" it is at its greatest stability, but specimens from other areas, including the Chanchamayo Valley, the type region of *jelskii*, show enough of the same features to make clear distinction difficult. Whether the name *jelskii* is used, therefore, for this intermediate population or for the one I prefer to call *boliviana*, the bulk of the population will be at some variance from the topotypical series. This is in addition to the fact that Taczanowski described *jelskii* from an abnormally small individual of the species of which he had another example from the same locality that he called "*tshudii*," in turn a misnomer since "*tshudii*" Gould was preoccupied by Sclater's use of it in another connection the year before Gould's account appeared! The nomenclature, therefore, is complicated.

In the Huayabamba Valley (including Achamal) the birds show the green gorget abbreviated, with the terminal margin somewhat truncate, followed by a greenish blue or bluish green triangular area within the black necklace which, in turn, is complete but noticeably weaker than in *viridipectus*. Some examples show a gradual transition from the green of the upper throat to this lower bluish portion, but all the examples at hand have the blue in evidence, even if sharply defined from the green space and approaching the more violaceous color of the breast below the necklace.

As mentioned in the discussion of *viridipectus*, specimens from the vicinity of Moyobamba, a few miles north of Achamal but in the Río Mayo Valley, show a preponderating similarity to *viridipectus* with a minority suggesting the Huayabamba birds. A single example from Chayavitas also appears to be referable to *viridipectus*. It is surprising, therefore, that two specimens from Chamicuros, not far from Chayavitas though across the lower Huallaga, show approximation to the Huayabamba series, not to the fullest extent but sufficient to keep them from assignment to *viridipectus*, although a good series from Chamicuros might show an influence of *viridipectus* not evidenced by either of these two birds.

A more interesting specimen is one of Gould's "Ucayali" speci-

mens on which he planned to erect his "*tschudii*," unfortunately nullified by Sclater's use of the name for specimens of *viridipectus*. This "Ucayali" bird has the black necklace as shown by the Huayabamba specimens, and has pronounced blue within the bight of the dark line, but it is of a somewhat different pattern of development. Beginning on the posterior sides of the throat, the green of the gorget becomes increasingly tinged with blue so that the blue area is laterally more extensive than in the Huayabamba birds in which it is confined principally to the center of the region. Gould's plate of his "*tschudii*" shows a gradual transition across the breast much as in the Huayabamba birds.

Hellmayr (1907, *Novitates Zool.*, vol. 14, p. 77), in calling attention to the blue throat patch of the Huayabamba population which he referred to Gould's "*tschudii*," doubted the Ucayali origin of Gould's specimens, but I am not so convinced. Considering the intermediate nature of the blue-marked birds, such intermediacy might appear on the lower Ucayali, at that point in the periphery of the range of *boliviana* which inhabits the upper Ucayali. Perhaps the style of blue coloration shown by this "Ucayali" bird may be constant in the lower Ucayali region, and, if so, it may be possible to recognize a separable form on that basis, but a good series is required to determine the exact nature and range of such variants. The two Chamicuros birds may belong in that segment, as, indeed, their pattern of coloration suggests. Such an assignment would give a more satisfactory explanation of distribution and affinity of the Chamicuros specimens than is now possible.

The Chanchamayo Valley birds are for the most part intermediate between the Huayabamba Valley series and *boliviana*. The black necklace is still weaker and usually interrupted in the middle, as it is in some Huayabamba specimens; the blue patch on the lower throat is weaker and appears as a bluish tinge at the lower margin of the green gorget, expanded laterally about as in the "Ucayali" specimen though less prominently. One example is very close to *boliviana*; none is so strongly marked as the extreme examples from the Huayabamba Valley, but I believe their intermediate nature entitles them to inclusion with the Huayabamba, Chamicuros, and [?lower] "Ucayali" specimens under the oldest available name, *jelskii*.

It may be noted that Junín specimens from outside the Chanchamayo Valley (Pozuzo and Puerto Yessup) are *boliviana* and

show the characters of that form without affecting the validity of *jelskii* for the intermediate population.

A somewhat similar situation is presented in Nicaragua where a population exists that is intermediate between *townsendi* of Honduras and eastern Guatemala and *venusta* of Costa Rica and Panamá. I have nine males from Honduras, every one of which is intermediate in varying degree between the two adjacent forms.

Without an examination of the critical specimens, it is impossible to assign some of the earlier records to this form or to one of the others. Specimens from Sarayacu, Río Ucayali, probably belong here as do records from Santa Cruz, near Chamicuros. Huambo, Achamal, and Soriano belong with the series listed below under *jelskii*. Possibly some of the "Upper Amazon" or Río Javari material is Peruvian in origin and of the same assignment.

In this connection it may be well to call attention to a statement by Gyldenstolpe (1945, K. Svenska Vetenskaps. Akad. Handl., ser. 3, vol. 22, no. 3, p. 81) regarding a series of birds from the Rio Juruá, Brazil, which he identified as *T. f. simoni*, a form described by Hellmayr from Teffé, Brazil. Gyldenstolpe noted that *simoni* (as here identified) had the green throat in the male sex not abruptly defined from the blue of the belly but gradually merging with it. This feature is quite at variance with the character of true *simoni* and strongly suggests that the Juruá specimens belong to *jelskii* or at least to the population of the lower Ucayali which, at present, appears to belong to that form. The range of *jelskii* would thus extend eastward from the lower Ucayali to the Juruá—a range that is quite understandable. Further comments on *simoni* will be given on a later page.

***Thalurania furcata boliviiana* Boucard**

Thalurania furcata boliviiana BOUCARD, 1894, Genera of humming birds, p. 107—Bolivia; Paris Mus.

As mentioned in the discussion of *jelskii*, birds from the upper Ucayali and the neighborhood of Pozuzo and Puerto Yessup belong to the Bolivian form to which southeast-Peruvian specimens also belong. In this form, the green gorget is relatively short, being truncate or double-rounded on its posterior margin. The black necklace of *nigrofasciata* is so broadly interrupted in the middle and withdrawn to the sides that it is at best inconspicuous as a pair of isolated dark patches and is frequently quite lacking.

In some young birds, there is a suggestion of blue at the upper end of the purplish violet area adjacent to the green gorget, but other young birds show none of it, being uniformly colored below the green throat as are the adults, although the young birds may show the entire lower under parts lighter and more bluish, less violaceous, than older birds.

The under tail-coverts in *boliviana* usually show some whitish marginal stripes or patches in the adult males, but occasionally they are nearly uniform steely black, especially in birds from the upper Ucayali where some approach to the characters of *jelskii* might be expected. In *jelskii*, these coverts are more uniform, as a rule, although not constantly so in any part of the range.

Records that may be assigned to *boliviana* are from Cumaria, Huaynapata, Río Cadena, and Carabaya.

Before leaving *Thalurania furcata* I should like to record a specimen from Teffé, Brazil, the type locality of Hellmayr's *T. f. simoni*, which is at decided variance from the type and male paratype of that form, now before me. *Simoni* was described as resembling "*jelskii*" (= *boliviana* as here considered) except for certain details that are given, in most of which *simoni* is said to agree with *balzani*; the difference from *balzani* is noted as consisting of broad, dark, central stripes, edged with white, on the under tail-coverts instead of the pure white coverts of *balzani*. This new specimen from Teffé has the under tail-coverts nearly pure white, with pale brownish shaft streaks on a few of the shorter feathers—less than is shown by numerous examples of *balzani*. No specimen of *balzani* at hand, however, shows the prominent dark central markings of the two original males of *simoni*, and I hesitate to do more than suggest, therefore, that these two specimens are merely unusual examples of *balzani* in proximity to the range of *jelskii* or *boliviana*. *Simoni* has been recorded, without comment, from São Paulo de Olivença by Todd, 1942, and from the Rio Juruá by Gyldenstolpe, 1945. The Juruá birds, however, can hardly belong to *simoni*, since Gyldenstolpe notes the fact that (presumably in his specimens) "*simoni*" has the green of the throat gradually merging with the blue of the belly, a character of *jelskii* but not of *simoni* which shows sharp definition between throat and breast. I conclude, therefore, as previously noted, that the Juruá birds may belong to *jelskii* but not *simoni*.

Nevertheless, the third male from Teffé emphasizes the inter-

mediate nature of *simoni* which a larger series may prove to be only an extreme of *balzani*, its nearest relative at present. *T. f. furcatoides* from the Pará district, which differs from *simoni* principally by darker upper surface and a violet band connecting the scapular patches, shows even more variation in the color of the under tail-coverts which are sometimes nearly pure white and sometimes with only a feeble development of whitish edges. It will be necessary to have more than three males from the Teffé region before it can be determined with certainty whether the predominant pattern of the coverts is that of the type of *simoni* or that of *balzani*.

SPECIMENS EXAMINED

T. f. townsendi.—

NO LOCALITY: 1 [♂].

T. f. townsendi × *venusta*.—

NICARAGUA:

(Savala, Eden Mine Hill, Río Coco, Los Sabalos, Río Grande, Matagalpa, Tuma, and Peña Blanca), 9 ♂, 11 ♀.

T. f. venusta.—

COSTA RICA:

(Aquinares, Carrillo, Bonilla, Pozo Azul, Tucurrique, Guapiles, Atalanta, Puerto Jiménez, Hacienda La Iberia, Guayabo, and Volcán de Oso).
21 ♂, 11 ♀, 2 (♀).

PANAMÁ:

(Veragua, [Lion Hill], Brava I., Chitrá, Agua Dulce, Almirante, Cocoplum, Santa Fé [Veraguas], Río Calovevora, Boquete, Gatún, Chiriquí, and Bogava), 31 ♂, 5 ♀, 1 (?).

T. f. fannyi.—

PANAMÁ:

(Tarcacuna and Tapalisa), 4 ♂, 4 ♀.

COLOMBIA:

(Buenavista, Juntas de Tamaná, La Vieja [Chocó], Alto Bonita, and "St. Bonaventure" [cotype]), 8 ♂, 4 ♀ (including cotype).

ECUADOR:

(Paramba, Cachiyacu, and Carondeled), 11 ♂, 7 ♀, 1 "♂" [= ♀].

T. f. colombica.—

COLOMBIA:

(El Consuelo, near San Agustín, Andalucía, La Candela, Santa Marta, Minca, Onaca, El Libano, Donamo, Las Nubes, Valparaiso, "New Grenada," "Bogotá," and "Colombia"), 45 ♂, 16 [♂], 11 ♀, 18 [♀], 2 (?).

VENEZUELA:

(Mérida and Azulita), 2 ♂.

T. f. subtropicalis.—

COLOMBIA:

(Río Dagua, Las Lomitas, San Antonio, Castilla, and "Cauca Valley"), 7 ♂, 1 "♀" [= ♂], 5 ♀.

T. f. verticeps.—

ECUADOR:

"Quito," 9 ♂, 5 ♀.

T. f. hypochlora.—

ECUADOR:

"Quito," 1 ♂, 2 ♀;

(Santa Rosa, Naranjo, Bucay, Gualea, La Chonta, Las Piñas, Río Pescada, and "Río Napo" [errore]), 11 ♂, 4 [♂], 1 "♀" [?=♂], 7 ♀, 3 [♀].

T. f. refulgens.—

TRINIDAD: 6 ♂.

VENEZUELA:

(Cumaná, Cristóbal Colón, Cuchivano, Santa Ana Valley, Los Palmales, San Antonio [Bermúdez], Montaña del Guácharo, Quebrada Seca, Campos Alegre Valley, La Tigrera, and "Venezuela"), 24 ♂, 4 ♀.

T. f. furcata.—

CAYENNE:

(Pied Saut, Ipousin, Cayenne, and "Cayenne" [trade-skins]), 13 ♂, 3 ♀.

SURINAM:

Pararah, 1 ♂.

BRAZIL:

Rio Jamundá, Faro, 1 ♂.

"VENEZUELA":

("Venezuela" and "State of Cumaná" [errore]), 2 ♂.

NO LOCALITY: 1 ♂.

T. f. fissilis.—

BRITISH GUIANA:

(Mines District, Potaro Landing, Kamakusa, Tumatumari, upper Mazaruni River, Minnehaha Creek, and "British Guiana"), 11 ♂, 8 ♀.

VENEZUELA:

(Suapure, La Prisión, El Llagual, Roraima, Arabupú, and Auyan-tepui), 24 ♂ (including type from Suapure [mountains]), 8 ♀.

T. f. orenocensis.—

VENEZUELA:

(Nericagua, Munduapo, [western] foot of Mt. Duida, Playa del Río Base, Foothills Camp, Pie del Cerro, Segundo Pico, Laterite Valley, and Agüita), 14 ♂ (including type from Nericagua), 14 ♀.

T. f. nigrofasciata.—

VENEZUELA:

Río Orinoco (Lalaja and mouth of Río Ocamo), 3 ♂, 1 ♀;

Río Casiquiare (Buena Vista, El Merey, opposite El Merey, Solano, and terrain between Huaynia and Casiquiare), 3 ♂, 3 ♀.

COLOMBIA:

Opposite Tahuapunto [Brazil], 4 ♂, 2 ♀;

junction of Río Huaynia and the Casiquiare, 1 ♂, 1 ♀.

BRAZIL:

Rio Uaupés (Tahuapunto and Iauarete), 4 ♂, 5 ♀;

Rio Negro (Tatú, Yavanarí, Tabocal, Cucuhý, Yucabí, Santa Maria, Manaos, and Muirapinima), 9 ♂, 15 ♀.

[CAYENNE]: "Oyapock" [errore], 3 ♂, 2 ♀.

T. f. viridipectus.—

COLOMBIA:

(La Morelia, Buena Vista, and "Bogotá"), 3 ♂, 2 ♀.

ECUADOR:

(Macas, Río Suno above Avila, lower Río Suno, below San José, Sarayacu to Capetaza, Guayabo, "Napo," Zamora, "Zamora or Gualaquiza," "Nanegal" [errore], "Ecuador," and "Quito-skin"), 24 ♂, 13 ♀.

PERÚ:

Mouth of Río Curaray, 5 ♂, 3 ♀, 1 ♀¹;

"headwaters of Marañón," 10 [♂];

Puerto Indiana, 9 ♂, 6 ♀, 1 ♂¹;

Pebas, 2 ♂;

Nauta, 1 ♂;

Iquitos, 3 ♂, 1 ♀;

"N.O. Peru," 1 ♀;

Río Mazán, 4 ♂;

mouth of Río Santiago, 3 ♂, 1 ♀;

Pomará, 6 ♂, 3 ♀, 1 (?);

Huarandosa, 2 ♂;

Moyobamba, 3 ♂¹, 1 ♀¹;

Río Seco, 4 ♂;

Río Negro, 4 ♂;

Chayavitas, 1 ♂, 1 ♀;

"Perú," 1 ♂.

T. f. jelskii.—

PERÚ:

Chamicuro, 2 ♂;

Ucayali, 1 ♂;

Guayabamba (Huayabamba), 6 ♂, 3 ♀;

Nuevo Loreto, 1 ♂, 1 ♀;

Tulumayo, 1 ♂, 3 ♀;

La Gloria, 1 ♂;

Borgoña, 1 ♂;

La Merced, 1 ♀;

Chanchamayo, 1 ♂², 3 ♀²;"Divisoria Fundo Sinchona," 1 ♂²;Río Colorado, 3 ♂².*T. f. boliviana*.—

PERÚ:

Pozuzo, 1 ♂;

mouth of Río Urubamba, 2 ♂;

Santa Rosa, Ucayali, 9 ♂;

Lagarto, 2 ♂;

Puerto Yessup, 4 ♂¹, 1 ♀¹;

Astillero, 12 ♂, 1 ♀, 3 (?);

Candamo, 3 ♂, 1 ♀, 1 (?);

¹ Specimens in Academy of Natural Sciences of Philadelphia.² Specimens in Chicago Natural History Museum.

Río Inambari, 2 ♂;
 Río Huacamayo, 2 ♂;
 Huacamayo, 1 ♂¹;
 La Oroya, 2 ♂¹;
 La Pampa, 1 ♂¹.

BOLIVIA:

(Yungas [Cochabamba], "Mapiri," Chairo, Todos Santos, mouth of Río San Antonio, Mission San Antonio, Santa Cruz, Vermejo, San Agustín, Province of Sara, and "Bolivia"), 19 ♂, 6 [♂], 13 ♀, 2 [♀].

T. f. simoni.—

BRAZIL:

Teffé, 3 ♂ (including type), 1 ♀.

T. f. balsani.—

BOLIVIA:

(Mapiri, Reyes, Salinas, and "Yungas"), 2 ♂ (including cotype from "Yungas"), 5 [♂], 1 ♀, 2 [♀].

BRAZIL:

(Santa Isabel [Rio Preto], Porto Velho, Calamá, Alliança, Borba, Igarapé Auará, Villa Bella Imperatriz, Santarem, Igarapé Brabo, Itaituba, Tauarý, Caxiricatuba, Aramanay, and "Amazonas"), 21 ♂, 2 [♂], 12 ♀, 1 [♀].

T. f. furcatoides.—

BRAZIL:

Rio Tocantins, Mocajuba, 3 ♂, 1 ♀;
 Baião, 1 ♂;
 Pará (Igarapé Assú, Prata, Utinga, Bemfica, Benevides, and Pará), 17 ♂, 1 "♀" [=♂], 9 ♀.

T. f. baeri.—

BRAZIL:

Goiás (Fazenda Esperanza, Goiás, Leopoldina, and Rio Uruhú), 7 ♂ (including type), 1 ♀;
 Piauí, Patos, 2 ♂, 1 [♂];
 Matto Grosso (Tapirapoan, Utiarity, Urucum, Belvedere de Urucum, Chapada, and Campos Novos), 25 ♂, 4 ♀.

T. f. eriphile.—

BRAZIL:

Minas Gerais (Sertão de Diamantina and Rio Jordão de Araguaçu), 3 ♂, 2 ♀;
 "Brazil," 3 ♂, 1 ♀.

PARAGUAY:

Zanja Morotí, 1 [♂].
 "ECUADOR" [errore]: 1 ♂.

***Hylocharis sapphirina* (Gmelin)**

Trochilus sapphirinus GMELIN, 1788, *Systema naturae*, vol. 1, p. 496—Guiana.
T[rochilus] latirostris WIED, 1832, *Beiträge zur Naturgeschichte von Brasilien*, vol. 4, pt. 1, p. 64—islands in Rio Belmonte, Cachoeirinha, Brazil; ♂ type (or cotype) in Amer. Mus. Nat. Hist.

¹ Specimens in Academy of Natural Sciences of Philadelphia.

Hylocharis Guianensis BOUCARD, 1891, Humming Bird, vol. 1, p. 52—River Carimang, Camacusa, and Merumé Mountains, British Guiana.

Hylocharis brasiliensis BOUCARD, 1893, Humming Bird, vol. 3, p. 7—Brazil [= Bahia].

Chamicuros, 1 ♂, 1 ♀; Puerto Indiana, 1 ♂; mouth of Río Curaray, 1 ♀.

Compared with 68 additional skins from Cayenne, British Guiana, southern Venezuela, northern Brazil, the Colombian side of the Río Uaupes, the Amazon Valley from the Rio Madeira to Pará, Bahia, Rio Janeiro, and Espirito Santo, including the type (or cotype, the only one of Wied's specimens extant) of *latirostris*. No distinctions appear in this series.

Other Peruvian records are from Pebas and Jeberos.

Hylocharis cyanus rostrata Boucard

Hylocharis cyanea rostrata BOUCARD, 1895, Genera of humming birds, p. 400—Rioja, Perú, type possibly in Frankfort Mus.

This form was described by Boucard from notes presumably supplied by Berlepsch in whose collection the type (or cotypes) may be preserved. The only certain character by which the form can be separated from *viridiventris* is the greater average length of the bill, since both subspecies agree in the general depth of coloration. There is a slight overlap in the length of the bill. Of 31 males of *viridiventris* measured, one has the bill 18 mm. in length; one, 17.5; 29, 15 to 17. Of the far fewer *rostrata* at hand, one has the bill 17.5; five, 18; one, 19; and one, 20.

There appear to be no records of *rostrata* from the southern part of Perú, but the form occurs in northwestern Bolivia and may occur in adjacent parts of Perú. Farther east in Bolivia there appears to be a decided approach toward the coloration of *cyanus cyanus* with the retention of the long bill of *rostrata*. With 20 specimens in good agreement on the characters, a new form may justifiably be recognized, as is described in more detail below.

One of the Bolivian specimens of *rostrata* (not sexed) lacks the glittering cap of the adult male plumage, having this area bluish green. The remainder of the plumage is that of the adult male, although the sides of the head and the malar region have a slight greenish tinge, apparent only in certain lights. The bill is relatively dark, with the maxilla wholly blackish and the mandible light brownish, with a more blackish tip. These features agree

in many respects with those described for "*Hylocharis pyropygia*," although the top of the head is said to be glittering in that supposed form.

Another Bolivian specimen (not sexed) has the forehead and sides of the head somewhat glittering bluish green, and the throat somewhat bluer, though not so strongly as in adult males. The belly is broadly whitish, and the tail is that of the female plumage, having the outer two pairs of rectrices broadly tipped with gray. Other specimens (of *rostrata* and the other forms), some sexed as males and some as females, show varying amounts of green color on the glittering feathers of the head and throat, particularly on feathers that give indications of recent development. From this I judge that "*pyropygia*" may possibly represent merely a stage of arrested development of the male plumage or an "advanced" condition of the female plumage. Certainly, in the various specimens here discussed I can see no admixture of *Chlorostilbon* characters as suggested by Berlioz (1938, Rev. Française d'Ornith., new ser., vol. 8, p. 18), which does not preclude the existence of such characters in the specimens examined by him. In any case, I suspect that the birds from Cumaria, Perú, reported as *pyropygia* by Dunajewski (1938, Acta Ornith., Mus. Zool. Polonici, vol. 2, p. 320), without a discussion of their characters, may be no more than variants of *rostrata* as noted herewith.

Other records of *rostrata* are from Rioja, Nauta, Jeberos, Chamicuros, and Moyobamba.

***Hylocharis cyanus conversa*, new subspecies**

TYPE: From Camp-woods, 750 meters, Province of Sara, Bolivia. No. 480547, American Museum of Natural History. Adult male collected June 24, 1906, by J. Steinbach; original no. 671.

DIAGNOSIS: Similar in coloration to *H. c. cyanus* of eastern Brazil (Bahia to São Paulo) but with the bill longer as in *H. c. rostrata* of eastern Perú and northwestern Bolivia. Differs from *rostrata* in the male sex by paler belly, with paler and weaker green tips in the area; under tail-coverts paler and usually more strongly margined with light edges.

RANGE: Eastern Bolivia and probably the Matto Grosso region of western Brazil and the Paraguayan Chaco.

DESCRIPTION OF TYPE: Forehead and crown glittering Deep Blue-Violet; back of head Forest Green, becoming a little lighter

on the mantle and bronzy on the rump, passing into coppery Chestnut on the upper tail-coverts. Sides of the head like the crown, with the blue color extending farther posteriad, leaving a narrow green stripe in the supra-auricular region; chin white, with terminal spots of Deep Blue-Violet; throat and breast Deep Blue-Violet; sides of breast like the back, with the green coloration passing posteriad along the flanks in a paler and weaker tone and spreading across the upper belly in still weaker condition; belly near Mouse Gray with only slight traces of dull greenish tips, visible in certain lights; femoral tufts and extreme lower belly silky white; longer under tail-coverts blackish brown, the remainder lighter brown, with narrow pale margins. Wings, including greater upper coverts and primary-coverts, purplish brown; median coverts similar, with green tips; lesser coverts like the back; under coverts dark green. Tail steely blue-black. Bill "meet-coloured [*sic*]; point black"; feet black. Wing, 54 mm.; tail, 29; culmen, 19.

REMARKS: Females above lighter green than the male and without the blue cap; posterior upper parts less deeply coppery; tail with median rectrices bronzy and outer two pairs more or less conspicuously and broadly tipped with light gray; under parts largely whitish, with green tips on the feathers of the sides; throat variably with or without evidence of the male gular coloration on the tips of the feathers; sometimes strongly spotted, sometimes immaculate. The general dorsal color is lighter than in females of *rostrata*.

I have not seen specimens from the Matto Grosso region of Brazil or from the Paraguayan Chaco, from both of which areas "*rostrata*" has been recorded. It is rather certain that the populations of these two areas belong to *conversa*.

SPECIMENS EXAMINED

H. c. viridiventris.—

SURINAM:

Vicinity of Paramaribo, 5 ♂, 1 ♀, 1 [? ♀].

BRITISH GUIANA:

(Essequibo River, Tumatumari, Merumé Mountains, Annai, "British Guiana"), 6 ♂, 2 ♀.

VENEZUELA:

(Roraima, Auyan-tepui, Nericagua, Suapure, Campos Alegre Valley, opposite mouth of Río Ocamo, above Ihuapo, LaLaja, Esmeralda, Mt. Duida [Savana Grande, Valle de los Monos, Campamento del Medio,

Playa del Río Base, Foothills Camp], opposite El Merey), 21 ♂, 15 ♀, 1 (?).

COLOMBIA:

Opposite Tahuapunto, 1 ♂;
junction of Río Huaynia and Casiquiare, 3 ♂, 2 ♀.

BRAZIL:

Rio Negro (Tatú, Cucuhy, Tabocal, Yucabí, Igarapé Cacao Pereira), 15 ♂, 17 ♀;
Rio Uaupés (Tahuapunto and Iauarete), 2 ♂, 2 ♀;
Rio Tapajoz, Itaituba, 1 ♂, 1 ♀;
Rio Tocantins, Mocajuba, 3 ♂, 3 ♀;
Pará, Prata, 2 ♂;
Ceará, Viçosa, 1 ♂;
"Brazil," 2 ♂.

H. c. cyanus.—

BRAZIL:

Bahia, 4 ♂, 1 ♀;
Espírito Santo (Lagõa Juparaná and Baixo Guandú), 13 ♂, 6 ♀,
Minas Gerais (São Benedicto and Rio Doce), 5 ♂;
"Rio de Janeiro," 4 ♂, 1 (?);
São Paulo, São Sebastião, 1 ♂.

H. c. rostrata.—

PERÚ:

Iquitos, 2 ♂;
Puerto Indiana, 1 ♂;
Río Negro, west of Moyobamba, 1 ♂;
Yarina Cocha, Río Ucayali, 1 ♂, 1 ♀.

BOLIVIA:

Salinas, Río Beni, 4 [♂], 4 [♀];
Reyes, Río Beni, 1 [♀].

H. c. conversa.—

BOLIVIA:

Camp-woods, Province of Sara, 10 ♂ (including type), 3 ♀, 2 "♀" [?=♂];
Todos Santos, 3 ♂, 1 ♀;
Mission San Antonio, 1 ♀.

[*Hylocharis grayi* (DeLattre and Bourcier)]

Trochilus Grayi DELATTRE AND BOURCIER, 1846, Rev. Zool., p. 307—Popayán, Colombia.

Heine and Reichenow (1884, Nomenclator Musei Heineani ornithologici, p. 180) record a specimen of this species from Perú, the only example in the collection. In the earlier book (1860, Museum Heineanum, vol. 3, p. 43), Cabanis and Heine record what is probably the same specimen as from "Neu-Granada." Since there is no supporting evidence of Peruvian occurrence and not even very close distributional approximation of either sub-

species to the Peruvian boundary, it appears probable that Heine and Reichenow were in error.]

[**Hylocharis chrysura** (Shaw)]

Trochilus chrysurus SHAW, 1912, General zoology, vol. 8, p. 335—Paraguay.

Two examples at hand are labeled "Peru," and three specimens in the British Museum are recorded with the same limited data. The species occurs in northwestern Bolivia, and it is not impossible that it reaches the southeastern corner of Perú, but there are no authentic records. In view of the uncertainty of Peruvian occurrence, it is best to leave the species on the hypothetical list.]

Chrysuronia oenone oenone (Lesson)

Ornismya oenone LESSON, 1832, Histoire naturelle des colibris, Supplément à l'histoire naturelle des oiseaux-mouches, p. 157, pl. 30—Trinidad.

Chrysuronia brevirostris MADARÁSZ, 1911, Ornith. Monatsber., vol. 19, p. 32—Ecuador.

The distribution of this form in Perú is somewhat unusual since it does not follow the Napo downstream as far as the mouth, where it is replaced by *C. o. josephinae*. It reaches the Marañón west of Nauta, possibly only beyond the Pongo de Manserriche. There are no specimens or records between Nauta (where *josephinae* appears to occur) and Pomará (in the range of *oenone*).

I can find no distinctions between north-Venezuelan birds and those from eastern Ecuador and Perú, although the intervening region is occupied by a slightly different population that has been named *longirostris* (Berlepsch, 1887, Jour. f. Ornith., vol. 35, p. 333—"Bogotá"). I have seen no adult males from any definite locality in Colombia, but 12 Bogotá trade-skins agree in having the bill 20 mm. or over in length, while 21 Venezuelan, Ecuadorian, and Peruvian males show a bill length of 18 to 19 mm., reaching 19.5 in only three examples of this series. Several additional males, labeled "New Granada," have bills of the shorter dimension, but they are not true "Bogotá-skins" and hence are of doubtful Colombian origin. Females have slightly longer bills than the males, and in this sex there is similar demarcation in length between three Bogotá-skins plus one female from Villaviciencio and numerous examples from Venezuela, Ecuador, and Perú. It seems probable, therefore, that *longirostris* may be able to stand as a recognizable form on the sole character of the greater length of bill. I can find no distinctions in color.

Some years ago (1930, Field Mus. Nat. Hist., zool. ser., vol. 17, p. 276), I reached other conclusions regarding *longirostris*, but at that time I did not appreciate the sexual difference in the length of bill in this species. In the light of the present study, a reëxamination of the measurements I noted shows that the single adult Bogotá male had the bill 20.5 mm. in length, while that of Trinidad, Venezuelan, and Ecuadorian males did not exceed 19 mm. The longer-billed birds I recorded at that time were all females of *oenone*. Consequently there is no disagreement with the present findings to dispute the apparent validity of *longirostris*.

There is some question as to the existence of a west-Ecuadorian form, *azurea* (Simon, 1921, Histoire naturelle des Trochilidae, p. 88—Paramba, Ecuador), based on the characters of bluer, less violet, anterior parts and dimensions like those of *longirostris*. I have a female labeled "W. Coast Ecuador"—a dealer's skin (H. Whitely) without full data—but it has a short bill, in agreement with east-Ecuadorian birds of the same sex. The degree of blueness on the head and throat of the males is not a character of great value in this species, since it is quite variable, depending to some extent on the age of the bird or the stage of development of the particular feathers, which appear to pass through a bluish stage before reaching the full violaceous coloration. Specimens in molt show this very well. The case of *azurea* (or of any occurrence of the species in western Ecuador) needs further confirmation.

I do not believe that *oenone* belongs in the genus *Hylocharis*, where it has been assigned by several authors. There are some similarities in coloration, but they are not peculiar to *Hylocharis* and *Chrysuronia*, while the prominent, seed-like expansion of the nasal operculum in *Hylocharis* is not developed in *oenone*.

Todd (1942, Ann. Carnegie Mus., vol. 29, p. 316) remarks on the apparent absence of records from the Mérida region of Venezuela. It may be well, therefore, to call attention to five specimens at hand from that area, from Azulita, Ejido, and Mérida.

Records of *oenone oenone* from Perú are restricted to the specimens listed below in the material examined.

***Chrysuronia oenone josephinae* (Bourcier and Mulsant)**

T[rochilus] Josephinae BOURCIER AND MULSANT, 1848, Rev. Zool., [vol. 11], p. 272—no locality [= Upper Amazon]

Chrysouronia oenone intermedia HARTERT, 1898, Novitates Zool., vol. 5, p. 519—Upper Amazon, especially near Pebas; ♂; Amer. Mus. Nat. Hist.

Hylocharis josephinae peruviana CARRIKER, 1935, Proc. Acad. Nat. Sci. Philadelphia, vol. 87, p. 345; Moyobamba, Perú; ♂; Acad. Nat. Sci. Philadelphia.

A series of over 60 examples of this species from Perú and Bolivia, other than the examples already discussed as *oenone oenone*, has presented considerable evidence concerning the distinction of a supposed blue-chinned form once separated as *intermedia*, and other possible variations.

Considering first the Peruvian series of more than 40 examples, the blue chin is, as has been pointed out by various authors, quite variable and apparently does not occur in all, or even most, adult males, even in regions most nearly adjacent to the range of the broadly blue-throated *oenone*. In the material now at hand, only five birds, including the type of *intermedia*, have the blue chin-spot well developed, and it is of varying size among these five. Three males, not all fully adult, show one or more blue feathers on the chin, the rest of which is green. Seventeen more males, either adult or nearly so, have a well-developed blue patch in the anterior malar region but no blue on the central part of the chin. The remainder of the males are too young to give any indication of presence or absence of blue in the regions mentioned. In a series of 14 males from northern Bolivia, most of them adult, none has a blue chin, one shows a single blue feather in that area, seven have blue in the anterior malar region, and four have none below the lores. Any distinction between Bolivian and Peruvian birds or any division of the Peruvian series must, therefore, rest on other factors, if any exist.

One character does appear to be of some value. In the Bolivian birds, particularly in the females, the rich coppery color of the upper tail-coverts tends to spread anteriorly over the lower part of the rump, while in all the Peruvian specimens, from the north bank of the Amazon to the southeastern Inambari region, the rump remains green like the back or has only a very narrow incursion of the coppery coloration. There is not a great deal of overlap in this respect between the two series in the material at hand, and it may be possible to recognize a Bolivian subspecies at least tentatively, or until even larger series may disprove it. The question remains as to the name to be applied to it.

When Bourcier and Mulsant described *josephinae*, they gave no locality for it, but in their description they make a significant

statement that the rump is green while the upper tail-coverts are coppery. In Mulsant and Verreaux's "Histoire naturelle des oiseaux-mouches" (1875, vol. 2, p. 10; 1878, vol. 4, pl. 9) they repeat and illustrate this detail, accepting the allocation of the species to the region of the upper Amazon, as proposed by various authors whom they cite. This appears to coincide with the features exhibited by the birds from the upper Amazon now before me. Bond and deSchauensee (1943, Proc. Acad. Nat. Sci. Philadelphia, vol. 95, p. 203) proposed Calabatea, Bolivia, as restricted type locality, but I believe the features of the type as described and figured by Bourcier and Mulsant and Mulsant and Verreaux argue against such allocation, and I have no hesitation in accepting the upper Amazon as typical and restricting the type locality to Pebas, Perú. Hartert's "*intermedia*," of course, falls as a synonym of *josephinae*, as Hartert himself (1922, Novitates Zool., vol. 29, p. 406) was prepared to admit.

The next name of undoubted application to a Bolivian form is *alleni* (*Agyrtria alleni* Elliot, 1888, Auk, vol. 5, p. 263—Yungas, Bolivia; Amer. Mus. Nat. Hist.), and the type exhibits well the extensive coppery color on the lower rump. It is not sexed but appears to be an adult female rather than a young male. Gould's "*caeruleicapilla*" (1861, An introduction to the Trochilidae, p. 165) appears from its diagnosis to be no more than an individual variant of either *josephinae* or *alleni*, but since it is without definite locality, only an examination of the type in the British Museum can resolve the question. If equivalent to *alleni* it will, of course, take precedence, since it antedates Elliot's name by many years.

As recognized here, therefore, *josephinae* (in the adult males) is a predominantly green-throated form that occasionally shows a narrow chin-spot of violet blue or one or more feathers of that color in the area, with the anterior malar region violet blue, and with the coppery color of the upper tail-coverts not strongly invading the rump; the last feature is equally, or more strongly, marked in the females. It crosses the Amazon to the north bank as at Iquitos, Pebas, and Nauta, but does not extend far up the Napo, where it is replaced by *oenone oenone* which reaches the Marañón as at Pomará but does not cross it.

Records of *josephinae*, not duplicated by material at hand, are from "Upper Amazons," Nauta, Moyobamba, Saposoa, Tarapoto, Huambo, Jeberos, Quimiri (La Merced), Perené, Chanchamayo, Huacamayo, and Huaynapata.

SPECIMENS EXAMINED

C. o. oenone.—TRINIDAD. 2 ♂¹, 1 ♀¹.

VENEZUELA:

(Cristóbal Colón, Quebrada Seca, Galipán, Campos Alegre Valley, San Esteban, Santa Ana Valley, Cumanacoa, Rincón San Antonio, Mérida, Ejido, and Azulita), 27 ♂, 2 "♀" [=♂], 11 ♀, 1 (?);

La Azulita, 1 ♀¹.

ECUADOR:

(Below San José, Zamora, near Zamora, Machiyaco, "Río Tigre" [a Quito-skin], "W. Coast Ecuador," "Ecuador," and "Napo"), 11 ♂, 14 ♀;

"Ecuador," 1 ♂¹, 1 ♀¹.

PERÚ:

Mouth of Río Curaray, 2 ♂, 2 ♀;

headwaters of Marañón, 7 [♂], 1 [♀];

Pomará, 3 ♂, 1 ♀.

"NEW GRANADA": 3 ♂, 1 ♀.

C. o. longirostris.—

COLOMBIA:

"Bogotá," 12 ♂, 4 ♀, 1 ♂¹;

Villavicencio, 1 ♀;

C. o. josephinae —

PERÚ:

Pebas, 4 ♂, 1 ♀, 1 ♂¹;

Iquitos, 1 ♀;

Puerto Indiana, 2 ♂;

"Perú," 2 ♂ (including type of "*intermedia*");

Río Seco, west of Moyobamba, 4 ♂, 1 ♀;

Rioja, 1 ♀¹,

Nuevo Loreto, 1 [♂];

Chinchao, 1 ♂¹;Vista Alegre, 1 ♂¹;

Santa Rosa, Ucayali, 11 ♂, 10 ♀;

Río Tapiche, 1 [♂];

Pozuzo, 1 ♂, 1 ♀;

Candamo, 2 ♂, 1 (?);

Astillero, 1 ♀;

La Pampa, 1 (?).

C. o. alleni.—

BOLIVIA:

Yungas, 1 (?) (type);

Mapiri, 2 ♂;

Reyes, 1 ♂;

Tres Arroyos, 1 ♂;

Todos Santos, 1 ♀;

San Agustín, 6 [♂], 2 [♀];

Guanay, 3 [♂], 2 [♀].

¹ Specimens in Chicago Natural History Museum.

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STUDIES OF PERUVIAN BIRDS. NO. 59

THE GENERA *POLYTMUS*, *LEUCIPPUS*,
AND *AMAZILIA*

BY JOHN T. ZIMMER

I am indebted to Mr. James Bond and Mr. Rodolphe M. de Schauensee of the Academy of Natural Sciences of Philadelphia, and to Dr. William H. Phelps of Caracas, Venezuela, for the loan of important comparative material used in the following studies.

Names of colors are capitalized when direct comparison has been made with Ridgway's "Color standards and color nomenclature."

***Polytmus theresiae leucorrhous* Sclater and Salvin**

Polytmus leucorrhous SCLATER AND SALVIN, 1867, Proc. Zool. Soc. London, p. 584—"Cobati, Rio Negro" [=Rio Cubate, an affluent of the Rio Içanna], Brazil, cotypes in British Mus.

Polytmus leucoproctus [errore] G. R. GRAY, 1869, Handlist of birds, pt. 1, p. 128.

Two specimens from northern Perú are not distinguishable from north-Brazilian and south-Venezuelan specimens of this form. Neither Peruvian specimen has any green markings on the under tail-coverts, although Taczanowski (1884, Ornithologie du Pérou, vol. 1, p. 373) describes a north-Peruvian male as having a small green spot on these feathers.

A good series of specimens from other parts of the range shows that the character is not perfectly constant as, indeed, Taczanowski's description also indicates. Eight birds from Mt. Duida have immaculate under tail-coverts, and two have a very slight green or brown shaft-streak on a few feathers. Thirteen of 21 Río Huaynia birds have the coverts pure white; six have a slender

green streak on a few feathers; two have a more prominent central spot of green. Upper Rio Negro (Brazil) birds have the proportion of $2/2/5$. None of these last five or the two most strongly marked Huaynia birds have the coverts entirely green as they are in many of the males of typical *theresia*, but show a prominent white border enclosing the green spot. Hence, since the localities are very near the type locality of *leucorrhous* and since some of the examples show the immaculate coverts, I refer all these specimens to *leucorrhous*.

Some of the specimens from the Rio Madeira have the under tail-coverts no more solidly green than the extreme examples mentioned from the Huaynia and the upper Negro, but those so marked are either females or young males, with the tips of the outer three or four pairs of rectrices white. Only one bird in adult male plumage (although sexed as a female) is at hand from the Madeira, and it has the under tail-coverts almost entirely green, agreeing with males from Pará, the Tocantins, and the Tapajoz, from which it is evident, as claimed by Hellmayr, that the Madeira population belongs to typical *theresia*. Purús birds, according to Todd, are *leucorrhous*.

Although the type locality, "Cobati," is in the general upper Rio Negro region of northern Brazil, it is not directly on the Negro. Wallace, in his "Travels on the Amazon," recounts his visit to the Rio Cobati (Cubate on the Millionth Map of the American Geographical Society), a southern affluent of the Rio Içanna, up which he traveled for parts of three days before establishing himself at a native village he does not name. This is undoubtedly the place where the present form was collected.

Sclater (1892, Catalogue of birds in the British Museum, vol. 16, p. 177) indicates specimens collected by Bartlett on the upper Amazon as [co]types of *leucorrhous*, but the original description mentions no locality but "Cobati" which is therefore accepted as the true type locality.

I am unable to appreciate any generic distinction among *Polytmus*, *Smaragdites*, and *Waldronia*. All three have the same peculiar style of iridescence and the same general coloration, with the tips of the outer three or four pairs of rectrices of the females and young males broadly white and the throat similarly spotted. "*Smaragdites*" has a small amount of white at the bases of the rectrices, "*Waldronia*" has more, and *Polytmus* (*sensu stricto*) has the most. "*Smaragdites*" has no white tips on the rectrices of the

adult males, "*Waldronia*" has more, and *Polytmus* (*sensu stricto*) has most. All three have the same shape of bill. *Polytmus guainumbi* has fine serrations toward the tip of the maxilla, "*Smaragdites*" does not, and while "*Waldronia*" appears to lack them, there is, in various specimens, a definite suggestion of irregular serration along the terminal part of the maxillary tomia. I believe, therefore, that there is not sufficient ground for the generic separation of *guainumbi* from the other two species, each of which, like *guainumbi*, is the type of a supposed monotypic genus. I propose the inclusion of "*Smaragdites*" and "*Waldronia*" in the genus *Polytmus*, including *Polytmus theresiae theresiae*, *Polytmus theresiae leucorrhous*, and *Polytmus milleri*.

Peruvian records are from Jeberos (including "Huallaga River"), upper Amazon, and "Siguin, Ecuador" [= Siguiri, Perú].

SPECIMENS EXAMINED

P. t. leucorrhous.—

VENEZUELA:

Mt. Duida (Esmeralda, LaLaja, Campamento del Medio, Valle de los Monos, and Savana Grande), 7 ♂, 3 ♀.

COLOMBIA:

Río Huaynia, junction with the Casiquiare, 20 ♂, 1 ♀.

BRAZIL:

Rio Negro (Cucuhy and Tatú), 9 ♂.

PERÚ:

Jeberos, 1 ♀;

"Perú," 1 ♂.

P. t. theresiae.—

CAYENNE: 5 ♂, 2 ♀.

SURINAM:

("Surinam" and near Paramaribo), 1 ♂, 1 ♀.

BRITISH GUIANA:

(Tumatumari, Annai, Merumé Mountains, Wismar, and "British Guiana"), 4 ♂, 1 "♀" [= ♂], 1 ♀.

BRAZIL:

Rio Jamundá, Faro, 1 ♂;

Rio Negro (Manaos and Muirapinima), 2 ♂, 4 ♀, 1 "♂" [= ♀];

Pará (Pará and Prata), 2 ♂;

Rio Tocantins, Mocajuba, 3 ♂, 1 ♀, 1 (?);

Rio Tapajoz (Igarapé Amorín, and Igarapé Brabo), 3 ♂, 1 ♀;

Rio Madeira (Borba and Humaythá) 4 ♂, 1 "♀" [= ♂], 1 ♀;

Rio Preto, Santa Isabel, 1 ♀.

Leucippus baeri Simon

Leucippus Baeri SIMON, 1901, Ornith., vol. 11, p. 202—Tumbes, Perú = Caleta Grau, Province of Tumbes; cotypes (not sexed) in Amer. Mus. Nat. Hist.

The three original specimens of this species are at hand. They are labeled "type" but must be considered as cotypes. The original description cites no individual specimen as holotype.

A fourth individual from Alamor, Piura, demonstrates a slight extension of range to the southward. This bird, a male (the cotypes are not sexed), differs from the other examples to a minor degree by having the chin a little more whitish, with faintly indicated darker centers, the breast slightly grayer and less brownish, and the subterminal dusky band on the outermost rectrices broader, with a correspondingly narrower grayish terminal area without the white terminal edge that may, however, have been worn off since the tail is somewhat abraded. All specimens have the tips of the median rectrices golden brown as described by Simon.

There are no other Peruvian records. Alamor is not to be confused with the town of the same name in southern Ecuador, farther upstream above the Río Alamor at an elevation of 4550 feet. The Peruvian locality is on the lower part of the Río Alamor, about 4 miles below the junction of the Quebrada Pilares, on the western side of the Alamor, at an elevation of 350 feet. The river at this point forms the international boundary, but Alamor is on the Peruvian side.

Leucippus hypostictus hypostictus (Gould)

Aphantochroa hyposticta GOULD, 1862, Proc. Zool. Soc. London, p. 124—Ecuador; British Mus.

Examples are at hand from the mouth of the Curaray and the "Headwaters of Marañón" which are quite indistinguishable from east-Ecuadorian birds and permit the inclusion of *h. hypostictus* in the Peruvian list. No definite locality on the Marañón is established and in view of the extensive collections made at the mouth of the Napo without the species being found at that spot, it appears probable that it is withdrawn a short distance upstream and does not reach the Marañón itself, except perhaps farther to the westward. Some such distribution was found in *Chrysuronia oenone oenone*, although, as mentioned in the discussion of that

species (1950, Amer. Mus. Novitates, no. 1474, p. 27), the allied *C. o. josephinae* occurs at the mouth of the Napo. In the present species, no representative form is known in the area in question, and *h. peruvianus* does not cross the Marañón to the north bank as far as is known.

There are no earlier Peruvian records except of examples presumably referable to *peruvianus*.

***Leucippus hypostictus peruvianus* (Simon)**

T[ephropsilus] hypostictus peruvianus SIMON, 1921, Histoire naturelle des Trochilidae, pp. 103, 319—Perú (San Antonio, valley of Paucartambo, Soriano, and Huambo) and Bolivia (Mapiri).

I am not certain of the validity of this supposed subspecies. The character of bill longer than in *hypostictus* is certainly useless, since specimens of that form at hand are as long-billed as *peruvianus* is said to be (24–25 mm.), although others are not. A male from Río Seco, west of Moyobamba, which is tentatively referred to *peruvianus*, has the bill only 23 mm. in length; in the series of *hypostictus* it varies from 20.5 to 25.5. The Río Seco bird, however, has the scapulars and upper wing-coverts greener than the decidedly coppery interscapulars, in which respect it cannot be matched exactly by any bird at hand from north of the Marañón, and since this is one of the characters given by Simon, it may well substantiate his claim for the distinction of *peruvianus*. Various specimens of *hypostictus* are as coppery or bronzy as the Río Seco bird, but the color is uniform over the back. Many examples, however, are not at all bronzy above, and the whole dorsal surface is dark green. I am unable to appreciate the violaceous tone of black he mentions on the terminal portion of the outer two pairs of rectrices, or the bluish hue of the median feathers. Some of the specimens of *hypostictus* have the tail noticeably bluish, but the Río Seco bird does not.

The characters of *peruvianus* are, therefore, not very satisfactory and as exhibited by the Río Seco specimen are of such a nature that they should be substantiated by a good series from Perú (south of the Marañón) and northwestern Bolivia before unqualified admission of validity. In the meantime, tentative recognition is here accorded to the form.

If the form is valid, records assignable to *peruvianus* are from Huambo, Soriano, San Antonio, Escopal, and Río Cadena.

I am unable to recognize the genus *Talaphorus* as distinct from *Leucippus*, especially after the species *chionogaster* and *viridicauda* are removed to *Amazilia*, as I believe they should be. In other words, *hypostictus*, *taczanowskii*, and *chlorocercus* appear to belong with *baeri* and *fallax* in *Leucippus*. Even with this arrangement, the assemblage is somewhat heterogeneous, especially as regards *hypostictus*, which may, perhaps, deserve segregation in a separate genus. The heavy coloration and the short under tail-coverts with strong green or bronzy centers, narrowly margined with whitish, give the species a distinctive appearance that sets it apart from any of the members of near-by genera and give it a superficial resemblance to certain species with which it cannot be associated. A generic name, *Taphrospilus*, is available for it, but I hesitate to recognize another monotypic genus on the basis of details of coloration alone, and continue the association with *taczanowskii* and its congeners in *Leucippus*.

SPECIMENS EXAMINED

L. h. hypostictus.—

ECUADOR:

Below San José de Sumaco, 3 ♂;
Río Pastaza, 5 (?);
Zamora, 4 ♂, 3 ♀;
"Ecuador," 3 (?).

PERÚ:

Mouth of Río Curaray, 3 ♂, 1 ♀;
headwaters of Marañón, 7 (?).

L. h. peruvianus.—

PERÚ:

Río Seco, west of Moyobamba, 1 ♂.

Leucippus taczanowskii (Sclater)

Thaumasius taczanowskii SCLATER, 1879, Proc. Zool. Soc. London, p. 146—Guajungo [Guajango, Province of Cajamarca], Perú; ♀; Warsaw Mus., presumably now lost.

Thaumasius taczanowskii fractus BANGS AND NOBLE, 1918, Auk, vol. 35, p. 451—Huancabamba, Perú; ♂; Mus. Comp. Zool., Cambridge.

Huancabamba, 1 ♂, 5 ♀, 1 (?); Pucará, 1 ♂, 1 ♀; Sondorillo, 1 ♂, 1 ♀; Callacate, 1 ♂, 1 ♀; Jaén, 1 ♀; San Felipe, 1 ♀; Perico (Río Chinchipe), 1 ♂, 1 ♀; Cajabamba, 1 ♀, 1 (?); Malca, 4 ♂; Succha, 1 ♂, 1 ♀; Viña, 1 ♀; Araquedá, 1 (?).

I do not see how "*fractus*" can well be maintained. In the first place, it was founded on a misconception of the type locality of

taczanowskii, and comparison was made with birds from "Malea" [Malca] and Otusco, both of which localities are somewhat distant from Guajango, which is not far from the mouth of the Río Huancabamba. Although I have not seen Guajango specimens, they are more likely to agree with Río Huancabamba specimens than with those from Malca and near-by localities. Two examples from Callacate, even closer to Malca than is Guajango, are like the Huancabamba series at hand. Sclater (1892, Catalogue of birds in the British Museum, vol. 16, p. 193) erroneously cites other Callacate specimens as "types," although his original account concerned only material from Guajango.

Compared with Río Huancabamba and Callacate examples, the specimens I have from the Cajabamba region (including Malca) are doubtfully distinct. They may average a little less deeply green on the upper parts, although only two specimens from the Huancabamba region are definitely darker; the under tail-coverts average less prominently centered with brown; and the wings average a trifle longer although with considerable overlap (66.5 to 73 mm. as against 64.5 to 71). The range of measurement in the bills is identical in both series (22 to 25.5), although one of the diagnostic features of "*fractus*" was said to be its much shorter bill.

I am doubtful, therefore, of the distinctness of the Huancabamba and Cajabamba populations and believe in any case that the Huancabamba birds will be found to agree with Guajango examples. If such is the case, "*fractus*" would fall as a synonym of *taczanowskii* even should the Cajabamba population be considered a distinguishable form. At present I am unwilling to admit it.

It may be noted that the two Callacate birds are more brownish on the upper surface than any of the others which agree well among themselves in this respect. I have seen no specimens from the western side of the Western Andes of which there are several records, nor from the Central Andes, of which there are two records. Records are from Guajango, Paucal, Choquisongo, Otusco, Araqueda, Chusgón, Cajamarca, Balsas, and Huaylillas.

***Leucippus chlorocercus* Gould**

Leucippus chlorocercus GOULD, in Sclater and Salvin, 1866, Proc. Zool. Soc. London, p. 194—upper Ucayali, Perú [?Cashiboya]; cotypes in British Mus.

Pebas, 1 ♂, 1 ♀; Apayacu, 2 ♀; mouth of Río Curaray, 2 ♀; "Napo," 1 (?); Sarayacu, 2 ♂.

This species, similarly to *viridicauda*, has a limited distribution and is of uncertain affinities. In some respects it resembles *viridicauda*, as mentioned under that form, but it differs in various other particulars and no relationship is clearly evident.

Additional records are from Nauta, Iquitos, and Elvira. Cashiboya is tentatively suggested as the type locality since it was the highest point on the Ucayali reached by Bartlett, the collector of the type, but it remains to be demonstrated that the species occurs that far up the river. My only Ucayali birds are from Sarayacu.

Amazilia chionogaster chionogaster (Tschudi)

Tr[ochilus] leucogaster TSCHUDI (*nec* Gmelin), 1844 (May), Arch. Naturgesch., 10th year, vol. 1, p. 297—Perú [= Chanchamayo Valley; I suggest La Merced]; Mus. Neuchâtel.

Tr[ochilus] chionogaster TSCHUDI, 1845, Fauna Peruana, Aves, p. 39, pl. 22, fig. 2 [*Trochilus leucogaster* on plate]—new name for *Trochilus leucogaster* Tschudi.

Leucippus pallidus TACZANOWSKI, 1874, Proc. Zool. Soc. London, p. 542—Huanta, Perú; ♂; Warsaw Mus., presumably lost.

This form occupies most of the Peruvian part of the specific range, except in the extreme southeastern portion of the country where the next form appears to exist. A single female from Santa Ana, Urubamba Valley, is still closer to *chionogaster* than to *hypoleuca*, although it shows some reduction in the spotting on the sides of the throat—a character of *hypoleuca* that is not entirely definitive.

One character that appears to be of considerable value in the distinction of the females of *chionogaster* and *hypoleuca* but that I have not found mentioned by other workers is the pattern of the outer three pairs of rectrices. Judging by the few females of *chionogaster* I have available, including the Santa Ana bird, in females of that form the inner web of the outermost rectrix is almost entirely white or whitish, with only an indistinct or at least poorly defined and limited area of shading toward the tip and with no more than a narrow terminal border of white on this and the two or three adjoining feathers. In the females of *hypoleuca* there is a sharply defined and broad white patch at the tip of the inner web of the three outer rectrices, and the inner margins of these feathers are narrowly but rather sharply white. Infrequently there is an approach toward the pattern of *chionogaster* on

the outermost feather, but the dark subterminal area is farther from the tip than in the typical form, leaving the white tip still of the characteristic breadth. In the males, the narrower dark tips of the feathers in *c. chionogaster*, with the inner webs of the outer feathers white to the shaft, exposed beyond the tips of the under tail-coverts, sometimes to the tips of the feather, supplement the less broadly white under parts as diagnostic characters. The bill averages shorter in *chionogaster*, but there is too much overlap for the character to be of any value except in extreme cases.

Since *A. viridicauda* occurs at very nearly the same place in the Urubamba Valley (and perhaps elsewhere) as *chionogaster*, it is impossible to say whether an unspecified number of specimens secured by Whitely at Huíro may not have included the present species. Berlepsch obtained one of the Whitely birds and found it to belong to a new species which he named *viridicauda* (see account of that species) and Sclater identified a male in the British Museum from the same source as that form. Both Taczanowski and Simon include Huíro in the range of both species, but without critical comment to show that they had seen the pertinent material. I judge, therefore, that these two authors gave uncritical acceptance of the first recording of all the Whitely specimens as *chionogaster* before *viridicauda* was described (Sclater and Salvin, 1876, Proc. Zool. Soc. London, p. 17).

There may be other records in the following list of localities that belong to *viridicauda*, but without the specimens I am unable to determine the fact with certainty. None of them suggest the existence of such error. The localities of record, other than those from which material has been examined, are Río Jelashte, Huacapistana, Auquimarca, Hacienda Huarapi (Dept. Huánuco), Chirimoto, Pumamarca, Soriano, La Merced, Pampa Jesús (Junín), Higos, Moyocuchu, Charay, Huanta, Anco, Araqueda, and Huamachuco. The Warszewicz female from "Perú" mentioned by Sclater (1892, Catalogue of birds in the British Museum, vol. 16, p. 202) as the probable female of *viridicauda* must belong to *chionogaster* or *hypoleuca*, since it is said to have the base of the rectrices pale, which is not the case in *viridicauda*.

***Amazilia chionogaster hypoleuca* (Gould)**

Trochilus (—?) *hypoleucus* GOULD, 1846 (Nov.), Proc. Zool. Soc. London, pt. 14, p. 90—Bolivia; ♀ ♀ cotypes in British Mus.

Trochilus Turnerii BOURCIER, 1846 (Nov.), Rev. Zool., vol. 9, p. 313—Bolivia: ♂; Amer. Mus. Nat. Hist.

Leucippus leucogaster longirostris SCHLÜTER, 1913, Falco, p. 42—Province of Salta, Argentina.

Three male specimens in the Academy of Natural Sciences of Philadelphia, kindly lent by Mr. deSchauensee, furnish the only indication of the occurrence of this subspecies in Perú. They are rather darker green on the upper parts than the remainder of the series of *hypoleuca*, and the spotting on the sides of the throat is present but weak (being matched by examples both of *chionogaster* and *hypoleuca*). The limited extent of white on the inner webs of the outermost rectrices, however, points clearly to the Bolivian subspecies. There is a prominent but narrow white inner margin on these and the adjacent feathers, but the broader whitish base is entirely concealed beneath the under tail-coverts, leaving the exposed portion of the inner web, except for a narrow terminal border and the inner marginal line, broadly dark. This condition is found in *hypoleuca* but apparently not in *chionogaster*.

There is a question as to which of the names, *hypoleuca* or *turnerii*, has priority, since both appear to have been published in November, 1846. I therefore follow the first acceptance of one name in preference to the other which appears to have been given by Simon in 1921. Curiously, both Mulsant and Verreaux, and Elliot, cite Gould's name as of 1857 which is quite incorrect.

Simon (1921, *Histoire naturelle des Trochilidae*, p. 318) makes the curious statement that Tschudi's *leucogaster* was another species than his *chionogaster*, basing this conclusion on part of the original diagnosis that appeared to be at variance with the present species. Tschudi, however, repeats these characters in the diagnosis of *chionogaster* which he further says is a new name for *leucogaster*, preoccupied for another species. If one name is inapplicable to the present species, the other is equally so; but there is little doubt that the present species is the proper recipient of the name *chionogaster* and Tschudi's longer description can apply to no other species.

I am unable to consider this species and the next to be discussed, *viridicauda*, as belonging to the genus *Leucippus*. I believe they are so close to *Amazilia candida* and *chionopectus* that all of these must be congeneric, and since it appears impracticable to separate *candida* and *chionopectus* from the genus *Amazilia*, I place *chionogaster* and *viridicauda* also in *Amazilia*.

SPECIMENS EXAMINED

A. c. chionogaster.—

PERÚ:

Guayabamba (Huayabamba), 3 ♂, 1 ♀;

Nuevo Loreto, 2 (?);

Chachapoyas, 3 ♂, 1 ♀;

?Piña, 1 (?);

Utcuyacu, 5 ♂, 3 ♀;

Rumicruz, 1 ♂;

Garita del Sol, 1 ♀;

Huánuco, 2 ♂¹;Chinchao, 2 ♂¹;

Santa Ana, Urubamba, 1 ♀.

A. c. hypoleuca.—

PERÚ:

Oconeque, 3 ♂².

BOLIVIA:

"Bolivia," 1 ♂ (type of "*Turnerii*");(Impona, Río Cachimayo, Tujma, Santa Cruz, California, Songo, Parotani, Pulque, Chilón, Río Pilcomayo, and Province of Sara), 20 ♂, 1 "♂"
[= ♀], 7 ♀, 2 [♀], 2 (?).

ARGENTINA:

(Tucumán, Tapia, Salta, and Río Bermejo), 7 ♂, 2 ♀, 2 (?).

Amazilia viridicauda* (Berlepsch)Leucippus viridicauda* BERLEPSCH, 1883, Ibis, ser. 5, vol. 1, p. 493—Huiro, Perú; ♂; Frankfort Mus.

Idma, 1 ♀, 1 (?); San Miguel, 1 ♀; Pozuzo, 1 ♀.

This species is very curious. It resembles *A. chionogaster* in so many particulars that relationship with that species might be indicated were it not for the fact that both occur in the Urubamba Valley very near to each other, quite probably together although the localities of record are slightly separated. At any rate, there is no other hummingbird to which *viridicauda* shows as close resemblance as it does to *chionogaster* from which it differs solely, as nearly as I can determine, by lacking all trace of the white basal portion of the rectrices and by having a noticeable greenish gloss on the under side of these feathers (as in *Amazilia chlorocercus*).

A female from Pozuzo offers a new locality for *viridicauda*. This specimen has the spotting on the sides of the throat and breast somewhat coarser than in the Urubamba specimens at

¹ Specimens in Chicago Natural History Museum.² Specimens in Academy of Natural Sciences of Philadelphia.

hand, and the upper parts are more bronzy, less dark green, although this latter feature is exhibited as an individual variation in *chionogaster* and may be of similar unimportance in the present species. This spotting tends also to occupy a wider area than is shown by the Urubamba specimens and may indicate a trend toward some form that has a completely spotted throat and breast as in *Amazilia chlorocercus*, although this species is not clearly involved. The limited distribution of *viridicauda* suggests that it may be allied to some more widely distributed species, but no such integration is evident. More information concerning this bird is highly desirable.

One Urubamba bird is not sexed; the other three examples are females, while the type and the Huero bird in the British Museum are sexed as males. As noted under *chionogaster*, the British Museum specimen listed as a female of *viridicauda* cannot belong to this species, since the basal part of the tail is said to be whitish, the character of *chionogaster*.

Records are from Huero, Ollantaytambo, and Marcapata. Simon (1921, *Histoire naturelle des Trochilidae*, p. 319) cites the last-named locality without further comment, and I am not familiar with the basis for its inclusion, although it is not improbable. He also cites "Sa. Anna" which may have reference to Idma, above Santa Ana, from which place specimens are before me.

***Amazilia fimbriata laeta* (Hartert)**

Agyrtria fluviatilis laeta HARTERT, 1900 (July), Jour. f. Ornith., vol. 48, p. 360—Nauta, Perú; Amer. Mus. Nat. Hist.

I am a little hesitant to recognize this subspecies whose color characters are not stable. The problem is rendered especially difficult by the uncertain type locality of *fluviatilis*, given simply as "Banks of the River Napo," whereas, if *laeta* is to be recognized, it also occurs on the Río Napo. However, Gould gives the measurements of his *fluviatilis* and, if we are willing to assume that he transposed the figures for the wing and bill, as seems obvious, *fluviatilis* is a longer-billed subspecies than *laeta*, as was maintained by Hartert when he described *laeta*. It is not, however, longer-winged on an average, although it reaches a slightly greater maximum. The same is true of the tail. Assuming that all the

"Napo" birds at hand came from the upper part of the river in Ecuadorian territory, only four of 15 Ecuadorian and Colombian birds measured have the wing longer than any Peruvian specimen; both series reach the same minimum. One Ecuadorian bird has a longer tail than any Peruvian specimen, but five of 36 Peruvian and west-Brazilian examples are shorter tailed than the Ecuadorian minimum. In respect to the bill, there is greater average distinction but still considerable overlap. Only one Peruvian bird comes within the average of the Ecuadorian examples; four others are very close and actually are at the figure of greatest frequency in the Ecuadorian measurements; but if one "Napo" bird is discounted as possibly from the lower part of the river, the remaining 34 Peruvian and Brazilian specimens have the bill shorter than any Ecuadorian or Colombian bird at hand. With the exception, then, of the single "Napo" specimen and five Peruvian birds, the 18 Ecuadorian-Colombian and 39 Peruvian-Brazilian specimens separate readily into two series, based solely on bill length. (Different numbers of specimens were measured for wing, tail, and bill lengths, since these members were imperfect in some examples.)

The measurements of the available series of both forms are given in table 1. I have detected no difference in dimensions of the sexes and, since much of the "Napo" material is non-sexed, I have used the figures irrespective of sex.

TABLE 1

COMPARATIVE MEASUREMENTS, IN MILLIMETERS (AVERAGES IN PARENTHESES)

	Wing	Tail	Culmen
<i>fluviatilis</i>	51-59 (55.1)	28-32 (29.7)	19-24 (21.3)
<i>laeta</i>	51-57.5 (55.0)	26-31 (28.7)	17.5-22 (19.1)

The color of the tail, used by Hartert to distinguish *laeta*, appears too variable to be of service. Hartert found *fluviatilis* (adult males) to have a broad, steel-blue tip on the median rectrices, while *laeta* had these feathers entirely green. Gould described the tail of *fluviatilis* as nearly uniform dull black. All three conditions occur throughout the ranges of both *fluviatilis* and *laeta*, and I am unable to make any clear segregation on this basis. In *fluviatilis* (as here recognized) one specimen has the exposed portion of the median rectrices nearly entirely blackish; nine have the tips blue, the basal portion green; two have these

feathers dull (dusky or bluish) green; five, clearer green. In *laeta*, the figures are seven, six, two, and six, respectively. There is thus a greater proportion of *laeta* with blackish, green, or dark green median rectrices, and a smaller proportion with dark-tipped green feathers, but the overlap is too great to make the character of much service.

With the separation indicated by the length of bill, *laeta* appears to extend up the Napo at least as far as the mouth of the Curaray and to range along the north bank of the Amazon from Nauta westward to a point I am unable to determine. Birds from Zamora, Ecuador, are assignable to *fluviatilis*, and I have no evidence that *fluviatilis* crosses the Peruvian border, although it may do so. Records presumably assignable to *laeta* include those from Yuriaguas, Jeberos, Tarapoto, and lower Ucayali.

There are several specimens that have the maxilla pale brownish instead of blackish, and various intermediates also occur. I am unable to correlate this with season, sex, or age. Several individuals exhibit a decidedly coppery hue on the upper tail-coverts, and others have the top of the head bronzy. All these features appear to represent only individual variations.

In describing *apicalis*, Gould called attention to pure white tips on the four outer tail-feathers. Simon (1921, *Histoire naturelle des Trochilidae*, p. 320, footnote 5) remarked that two Bogotá-skins in the British Museum considered as types of *apicalis* disagreed with this diagnosis and belonged to *terpna* (*A[gyrtria]* *terpna* Heine, 1863, *Jour. f. Ornith.*, vol. 11, p. 184—Bogotá) which was separated from *apicalis* by Heine by reason of a shorter bill and lack of the white tips on the rectrices. The last-named character is not of subspecific value, since it is of variable occurrence throughout the species, particularly among the females. The supposed difference in length of bill is problematical, since Gould's measurement was in the broad figure of "1 inch." The Gould skin at hand marked as "a type" has the exposed culmen only 21.5 mm. in length, but the culmen to concealed base is 26. The extreme tips of the outer two pairs of rectrices are quite narrowly pure white, preceded by broader grayish spaces. It is quite possible that these details are what Gould had in view. At any rate, "*terpna*" is a synonym either of *apicalis* or of *fimbriata*, as is further noted below.

The arrangement of the extralimital subspecies creates a great problem owing to the great amount of individual variation ex-

hibited by the birds from every locality. With the assistance of a fine series generously lent by Dr. William H. Phelps of Caracas, Venezuela, I have been able to reach a fairly satisfactory conclusion regarding the birds of that country where the greatest problem has centered.

In the first place, I am unable to find any distinction between the birds from Cayenne (*fimbriata*) and those from British Guiana and Mt. Roraima, Venezuela (*maculicauda*). The series at hand from these two areas cover the same range of variation from green to bronzy green on the upper surface of the median rectrices. A comparable series from Surinam is not greatly different, although it shows a slightly more bronzy extreme on the feathers mentioned, with only the slightest trace of coppery tinge in the most extreme examples. I consider, therefore, that *fimbriata fimbriata* ranges across all three Guianas to southeastern Venezuela. A few specimens from Mt. Ptari-tepui and immediately adjoining localities also agree well with the Guianan birds, but between this area and the lower Orinoco there is a significant approach toward the characters of the lower and middle Orinoco River birds. It is not certain to which form they are best referred.

South of the Roraiman highlands, specimens from the Rio Surumú and the upper Rio Negro, Brazil, are not distinguishable from *fimbriata*. Birds from the upper Orinoco of Venezuela and Colombia show their greatest affinity here also, although there is some indication of approach toward the middle Orinoco population. Even more significant, two birds from Villavicencio, Colombia, are still inseparable from *fimbriata* and can be matched with Guianan specimens. It appears, therefore, that *fimbriata* ranges south of the Pacaraima highlands and westward as far as the eastern face of the Eastern Andes of Colombia in the Orinoco drainage. In the Amazonian drainage, *fluvialis* occurs.

The identity of the Villavicencio birds is interesting, since they do not agree with Bogotá trade-skins, representing *apicalis*. Of *apicalis* I have eight "Bogotá-skins," including one received by Elliot from Gould, the author of that form, and marked "a type," possibly a cotype; also one apparently compared with original material and marked "agrees with type of *apicalis*." These birds have a heavier and often longer bill than *fimbriata*; the green of the breast has a definite bluish tone; and the median rectrices are not at all bronzy, in one case they are somewhat bluish. They do not have the under tail-coverts so heavily marked as *fluvialis*

and cannot be assigned to that form, although their bluish tinge suggests that they represent a population intermediate between that form and *fimbriata*. What exact area they occupy in Colombia, I am unable to tell with the material at hand. It is possible that "*terpna*" will be found to belong in this population.

It has been suggested that the type of Elliot's *Thaumantias nitidicauda* (1878, Ibis, ser. 4, vol. 2, p. 38—Cayenne) originated in the mountains of British Guiana, but this, I believe, is erroneous. The type, now before me, appears to be a "Cayenne" trade-skin, as was evidently concluded by Elliot when he gave the locality as Cayenne. The matter is of minor importance, since *nitidicauda* is antedated by *fimbriata* from Cayenne and *maculicauda* from British Guiana.

The birds of the lower and middle portions of the Orinoco show a definite shift in the scale of variability in the color of the median rectrices, compared with *fimbriata*. Greenish coloration without bronzy tones is uncommon, and at the opposite end of the scale there is a pronounced coppery hue that is absent from all the *fimbriata* I have except a single bird from Maipures, upper Orinoco. Occasional specimens show the median rectrices dark, without much coloration of green, bronze, or coppery tone, but this variation is found also in *fimbriata*, of even less common occurrence.

Birds from the northern coast of Venezuela are indistinguishable from the Orinocan specimens, and a series from the intervening plains shows no recognizable distinction. The average coloration of the median rectrices in this entire assemblage is definitely bronzy to coppery, and, in series compared with *fimbriata*, the distinction from the more definite green of that form is readily appreciated. For this population the name *elegantissima* Todd is available.

The lower Amazonian population appears to constitute a fairly consistent and recognizable form, for which I can find no available published name. It has been characterized by various authors as intermediate between *fimbriata* and *nigricauda*, but it also shares one character with *laeta*, *fluvialis*, and *apicalis*—the bluish tinge on the green of the anterior under parts. There is only one specimen in a series of more than 70 that has the median rectrices black and none that has the under tail-coverts completely white—characters that are preponderant in *nigricauda*. On the other hand, the under tail-coverts are not, with few exceptions, so

heavily centered or shaft-streaked with brown as in most *fimbriata* (even less so in comparison with *laeta* and *fluviatilis*), and the median rectrices are without even as much bronzy sheen as is prevalent in *fimbriata*. Only one Cayenne specimen out of over 60 from the three Guianas has the breast as bluish as do almost all of the lower Amazonian birds. This population, therefore, is as stable as any of the others, and since it occupies a fairly extensive region (from the left bank of the Rio Madeira to the Tocantins on the south bank of the Amazon, and the lower reaches of the Negro and Jamundá on the north bank) it appears to be entitled to a name. It may be known as follows:

***Amazilia fimbriata alia*, new subspecies**

TYPE: From Porto de Moz, Rio Xingú, Brazil. No. 429106, American Museum of Natural History. Adult male collected September 13, 1931, by Alfonso M. Olalla.

DIAGNOSIS: As detailed above.

RANGE: Rio Negro and Rio Jamundá near their mouths (north of the Amazon) and from the left bank of the Rio Madeira to the Rio Tocantins.

DESCRIPTION OF TYPE: Most of upper parts shining green, more golden away from the light, more bluish toward the light; upper tail-coverts with a deep bronzy tone; sides of head rather duller, with a small, white, postocular spot. Chin, throat, and breast glittering Emerald Green $\times$ Vivid Green away from the light, Skobeloff Green toward the light; mid-line of lower breast and belly narrowly white; flanks shining green, becoming weaker posteriorly; a white femoral patch; under tail-coverts whitish, with a moderately broad shaft-stripe of light brown. Remiges violaceous black, with a pale marginal line on the outer web of the outer remex; upper and under wing-coverts green, with a white line along the carpal margin. Median rectrices light Empire Green; remaining pairs black, with a trace of green toward the base of the outer web; outer two pairs with a grayish subterminal space; all rectrices, except the median pair, with a narrow white terminal margin. Bill (in dried skin) with the maxilla dark brown, darker toward the tip; mandible mostly yellowish, becoming brownish distally; feet dark brown. Wing, 58 mm.; tail, 32.5; exposed culmen, 20.5.

SPECIMENS EXAMINED

A. f. fimbriata.—

CAYENNE:

(Cayenne, Mana, Roche Marie, Approuague, Isle Le Père, and "Cayenne-skins"), 12 ♂, 1 ?♂, 13 ♀, 6 (?) (including type of *nitidicauda*).

SURINAM:

(Kwata, "savannah," and near Paramaribo), 10 ♂, 4 ♀, 4 (?).

BRITISH GUIANA:

Annai, 3 ♂, 1 ♀;

"British Guiana," 1 (?).

VENEZUELA:

Roraima, 3 ♂, 4 ♀, 1 (?);

Mt. Ptari-tepui, 2 ♀¹, 1 (?)¹;

Mt. Paurai-tepui, 1 (?)¹;

Candelaria, 1 (?)¹;

[Puerto] Ayacucho, 4 ♂, 2 ♀;

Río Cataniapo, 1 ♀;

Yavanari, 2 ♀;

San Fernando de Apure, 2 (?);

Mouth of Río Meta, 1 ♀;

Cerro Yavi, 2 ♀¹, 2 (?)¹;

El Platanal, 1 ♀¹;

San Fernando de Atabapo, 3 ♀¹, 1 (?)¹;

Cerro Yapacana, 1 ♂¹, 4 ♀¹;

Atures, 6 ♂¹, 2 ♀¹, 1 (?)¹;

El Oro, Río Ventuari, 1 ♂¹, 1 (?)¹.

BRAZIL:

Carvoeira, 2 ♂;

Frechal, Río Surumú, 3 ♀.

COLOMBIA:

Maipures, 4 ♂, 2 ♀;

Villavicencio, 2 ♂.

A. f. fimbriata × *elegantissima*.—

VENEZUELA:

El Palmar, Bolívar, 2 ♂¹, 2 ♀¹, 1 (?)¹;

Turmeremo, 1 ♂¹, 1 ♀¹, 1 (?)¹;

Cerro Tigre, 2 ♂¹, 4 ♀¹, 1 (?)¹;

Hacienda Santa Teresa, 1 ♂¹;

La Paragua, 6 ♂¹, 1 ♀¹.

A. f. elegantissima.—

VENEZUELA:

[Guasipata], 1 (?);

Las Barrancas, 1 ♂;

Ciudad Bolívar, 3 ♂, 3 ♂¹, 6 ♀, 1 ♀¹, 3 (?)¹;

Agua Salada de Ciudad Bolívar, 1 ♀;

Suapure, 1 ♂, 1 ♀;

Caicara, 1 ♂, 8 ♂¹, 1 ♀, 4 ♀¹, 3 (?)¹;

¹ Specimens in Phelps Collection, Caracas.

Altagracia, 3 ♂, 2 ♀;
 Caño Guaniamo, 2 ♂¹, 1 (?)¹;
 Union of Guaniamo and Cuchivero, 2 ♀¹,
 Cuchivero, 1 ♂¹;
 Cabruta, 4 ♂¹, 1 ♀¹;
 Santa Rita, Guarico, 1 ♂¹;
 Pariaguán, Anzoategui, 1 ♀¹, 1 (?)¹;
 Santa Maria de Ypire, Guarico, 1 ♂¹, 2 ♀¹, 7 (?)¹;
 Altagracia de Orituro, 4 ♀¹, 1 (?)¹;
 El Socorro, 2 ♂¹, 2 (?)¹;
 Palenque, 2 ♂¹, 1 ♀¹;
 La Caimarea, 1 ♂¹;
 Calabozo, 1 ♀¹;
 El Pilar, Sucre, 1 ♂¹;
 Bergantín, Anzoategui, 1 ♂¹, 1 (?)¹;
 Cerro Negro, 1 ♂¹, 3 ♀¹, 2 (?)¹;
 La Cumbre, Sierra Carabobo, 1 ♀¹;
 Hacienda Altamira, 1 ♀¹;
 Puerto Cabello, 1 (?)¹;
 Quiguas, 1 ♀¹;
 Urama, 2 (?)¹;
 San Casimiro, Aragua, 1 ♂¹;
 San Estéban, 1 ♂, 1 ♀;
 Las Trincheras, 2 ♂;
 Caracas, 1 ♂, 1 (?)¹;
 Canoa, Estado Miranda, 1 (?)¹;
 La Ciénaga, 1 ♀¹, 1 (?)¹;
 San Felipe, Yaracuy, 1 ♀¹;
 road, San Felipe to Nirgua, 3 ♂¹;
 Cumareba, 1 ♀¹.

A. f. apicalis.—

COLOMBIA:

"Bogotá" 8 (?) (including "a type").

A. f. fluviatilis.—

COLOMBIA:

La Morelia, 1 ♂.

ECUADOR:

"Napo," 9 (?)¹;

Gualaquiza, 1 ♀;

Zamora, 1 ♂, 3 ♀;

Río Pastaza, 2 ♂, 1 ♀.

A. f. laeta.—

PERÚ:

Mouth of Río Curaray, 4 ♂;

Apayacu, 5 ♂;

Puerto Indiana, 5 ♂, 6 ♀;

Pebas, 1 ♂;

Nauta, 1 ♂ (type), 2 ♀;

Iquitos, 2 ♂;

¹ Specimens in Phelps Collection, Caracas.

Río Mazán, 1 ♂;
 Río Tapiche, 1 (?);
 "Headwaters of Marañón," 1 (?);
 Sarayacu, 3 ♂, 1 ♀;
 Río Ucayali, 1 (?);
 "Upper Ucayali," 2 (?).

BRAZIL:

Teffé, 5 ♂, 1 ♀.

A. f. alia.—

BRAZIL:

Rio Madeira (Rosarinho and Borba), 9 ♂, 6 ♀, 1 (?);
 Villa Bella Imperatriz, 7 ♂, 4 ♀, 5 (?);
 Rio Tapajoz (Tauary, Piquiatuba, Igarapé Amorín, Igarapé Brabo, Inajutuba, Itaituba, and Urucurituba), 7 ♂, 8 ♀;
 Rio Xingú (Porto de Moz and Tapará), 4 ♂ (including type), 4 ♀;
 Rio Tocantins, Baião, 2 ♂, 3 ♀;
 Rio Negro (Igarapé Cacao Pereira, and Campos Salles, Manaos), 3 ♂, 3 ♀;
 Rio Jamundá, Faro, 4 ♂.

A. f. nigricauda.—

BRAZIL:

Maranhão (Kelsú, São Luiz, Santa Filomena, Flores, Barão de Grajaú, Rosario, and São João dos Patos), 4 ♂, 3 ♀, 6 (?);
 Pernambuco, Garanhuns, 1 ♂, 2 ♀, 3 (?);
 Ceará, Viçosa, 1 ♂, 4 (?);
 Piauí (Freicheiras, Urussuhy, "Tocums," Gilbues, Bello Horizonte, Corrente, and Parnaguá), 5 ♂, 7 (?);
 Bahia (Orobó, Iracema, Santa Ritta, Jiquy, Morro de Chapéu, Tambury, Barra, and Bahia, 17 ♂, 11 ♀, 11 (?);
 "Bahia" (trade-skins), 2 ♂, 15 (?);
 Goiás (Rio Thesouras and Leopoldina), 2 ♂, 2 ♀;
 Espírito Santo, 2 (?);
 Matto Grosso (Tapirapoan and Utariaty), 2 ♂, 1 ♀;
 "British Guiana" (= Bahia trade-skin), 1 (?);
 "Cayenne" (= Bahia trade-skin), 1 (?);
 "Trinidad" (= Bahia trade-skins), 3 (?) (type and paratypes).

BOLIVIA: 1 ♀.

A. f. tephrocephala.—

BRAZIL:

Santa Catharina, 1 (?);
 São Paulo (Ubatuba and São Sebastião), 1 ♀, 1 (?);
 "Brazil," 4 (?).

***Amazilia lactea bartletti* (Sclater and Salvin)**

Thaumantias bartletti SCLATER AND SALVIN, 1866, Proc. Zool. Soc. London, p. 194—"Upper Ucayali" [= Sarayacu, lower Ucayali, Perú]; cotypes in British Mus. and Amer. Mus. Nat. Hist.

Río Seco (near Moyobamba), 3 ♂, 1 ♀; Río Negro, 1 ♂; Rioja, 1 ♂; Tarapoto, 1 (?); "Huallaga sup.," 1 ♂; La Merced,

3 ♂, 1 ♀; Perené, 1 ♂, 1 ♀; Lagarto (Río Ucayali), 1 ♀; Santa Rosa, 2 ♂; Yarina-cocha, 1 ♂, 1 (?); "Perú," 1 ♂ (co-type).

I can find no constant distinctions in this series from different parts of its range. Since it is recorded from the La Paz region of Bolivia, it may possibly occur in the southeastern corner of Perú, although there are no records from that area. Records, other than those from localities represented in the specimens at hand, are from Sarayacu, Moyobamba, San Ramón, and Chanchamayo.

The type locality of *bartletti* is given by Sclater and Salvin, from notes by Gould, as "Upper Ucayali," but the only material available to Gould and to Sclater and Salvin comprised seven examples from Sarayacu which may thus be taken as the restricted type locality, although it is on the lower portion of the Ucayali. One of the original specimens (all collected by Bartlett) is in the collection at hand; its original label unfortunately has been replaced by the special label that Elliot supplied for much of his collection. According to Elliot (1878, *Ibis*, ser. 4, vol. 2, p. 53) Bartlett's seven specimens were still at that time the only ones known. Since six of Bartlett's birds remained in the British Museum, there is assurance that the example in hand is one of the original specimens.

The three subspecies of *lactea* are singularly scattered in distribution, with no other forms that appear to be likely candidates for the role of connectants.

Amazilia franciae cyanocollis (Gould)

Agyrtria (—?) *cyanocollis* GOULD, "1853" [1854], *Proc. Zool. Soc. London*, pt. 21, p. 61—eastern slope of the Andes of Perú; I suggest Huancabamba, Perú; ♂♂ cotypes in British Mus.

Viña, 1 ♂, 1 ♀; San Marcos, 1 ♂; Malca, 1 ♀; Callacate, 1 ♂, 1 ♀; Pucará, 1 ♂, 1 ♀; Lomo Santo, 1 ♂, 1 ♀; Cabico, 2 ♂; Jaén, 1 ♂, 3 ♀, 1 (?); Santa Rosa (Marañón), 1 ♂; Huancabamba, 5 ♂; Huarandosa, 2 ♂, 1 (?); Perico, 2 ♀; San Ignacio, 2 ♂.

Apparently restricted to the northern part of Perú in the Upper Tropical and Subtropical Zones. The cotypes were collected by Warszewicz, about whose uncertain itinerary I have had earlier occasion to comment. It is known, however, that he was in the general area covered by the localities here listed, from which I select Huancabamba as a satisfactory restricted type locality.

Other records are from Chirimoto, Succha, Chachapoyas, Utcubamba, and Balsas.

I can find no subspecific distinctions among the specimens examined.

***Amazilia amazilia dumerilii* (Lesson)**

Ornismya Dumerilii LESSON, 1832, *Historie naturelle des colibris*, Supplément des oiseaux-mouches, p. 172, pl. 36—northern provinces of Chile [error]; western Ecuador suggested by Chapman, 1926.

A [*mazilia*] *Amazilicula* "SAUC." REICHENBACH, 1854, *Jour. f. Ornith.*, vol. 1, Beilage zu Extraheft, p. 24—no locality [= western Ecuador].

This northwestern form of the species barely reaches Perú near the Ecuadorian boundary. This general area is occupied by a population that is variable, with tendencies toward *alticola* and *leucophoea* in such mixed degree that assignment to a single subspecies becomes problematical. Chapman (1926, *Bull. Amer. Mus. Nat. Hist.*, vol. 55, pp. 292–294) has discussed the problem with particular reference to the Ecuadorian specimens, and detailed comment need not be given here. The Milagros specimen at hand has the characters of *dumerilii* well marked; the Paletillas birds show a certain amount of rufous tinge on the outer rectrices as a suggestion of *alticola*, or possibly *leucophoea*.

Other than the localities mentioned, the only Peruvian record is from Tumbes.

***Amazilia amazilia alticola* Gould**

Amazilia alticola GOULD, 1860, *Proc. Zool. Soc. London*, p. 309—"Said to be the Puna district of Peru"; British Museum.

I hesitate to include this subspecies in the Peruvian list, since there is no unquestionable record of it from that country. Gould himself appeared to question the Peruvian origin of the type. There is, however, a limited area in the highlands of northern Perú, just south of the Ecuadorian boundary, from which I have no specimens or records, and it is not impossible that *alticola* reaches this region. Specimens of *leucophoea* from Palambra (the nearest locality to this area from which I have material) show a slight trace of *alticola* features. One specimen at hand, labeled "Perú," is intermediate in the direction of *leucophoea*, but without a more definite locality it offers no positive evidence for a solution of the problem. For the present, therefore, I believe *alticola* may

be retained in the Peruvian account. The "Puna region" undoubtedly is erroneous in any case, since the species does not inhabit the Páramo Zone anywhere in its range.

Amazilia amazilia leucophoea Reichenbach

Amazilia leucophoea REICHENBACH, 1854, Jour. f. Ornith., vol. 1, Beilage zu Extraheft, p. 24—"Süd-Peru, Vulkan Arequipa" [error, I suggest Trujillo, Perú]; cotypes in Frankfurt Mus.

I can see no justification for continuing the belief that Warszewicz collected *leucophoea* on the volcano Mt. Misti in Arequipa, or anywhere else in that part of Perú. No subsequent collector has been able to find it there, although birds referable to that form occur commonly in northwestern Perú, with two quite different subspecies living in the intervening area of western Perú, even as close to Arequipa as the department of Ica. It is obvious that some of the material collected by Warszewicz was inadequately or incorrectly labeled: for example, "*Chlorestes Euchloris*" Reichenbach, said to be from northern Perú but subsequently found only in Colombia. For this reason I have suggested, as a suitable restricted type locality, Trujillo.

One of the birds collected by Warszewicz is at hand, labeled "a type," but probably not one of the original specimens on which Reichenbach based his description; it may have been obtained from Gould who had several specimens from the same collector. At any rate, it permits comparison of a so-called "Arequipa" specimen with north-Peruvian specimens with which it agrees closely. The terminal green band on the median rectrices is weak in color, but the northern series is variable in this respect and I doubt any significance in this detail.

One female from Trujillo shows an approach toward *alticola* by reason of an unusual amount of green on the rectrices and traces of green centers on some of the upper tail-coverts. Six specimens from Palambla show similar traces on the coverts in varying degree, and two of them also show a slight increase in the width of the terminal band, although not to the extent exhibited by the Trujillo female mentioned.

Five specimens from Alamor, Perú (not the Ecuadorian locality of that name), show an even more definite trend toward a green tail, which may be considered as a transition toward either *alticola* or *dumerilii*. Two of the specimens are nearly or quite unmodified *leucophoea*. Two have the median rectrices mostly green, with a

rufescent basal area concealed by the upper tail-coverts which, in turn, are largely green in one specimen and largely rufescent in the other. The fifth bird has the median rectrices entirely green, the next pair almost as extensively so, and broad external margins of green on the next three pairs. The rufous area of the breast is not broken in the middle as in many *alticola*, and the bill is not so long as in that form, which leaves the balance in favor of considering the trend to be toward *dumerilii* rather than toward *alticola*.

Three birds from Pucará, Río Huancabamba, on the eastern side of the Western Andes, might be expected to show some approach toward *alticola* that also crosses the cordillera in southern Ecuador, but they show no such indication. Six birds from Palambla have the terminal green band on the median rectrices a little deeper in tone than usual, and in some of them a little wider than the average, while the upper tail-coverts have a trace of greenish color on the centers of some of the feathers, not well defined in all six examples. The rufous color of the rectrices is of a slightly darker shade than appears in most of the series of *leucophoea*. These various features apparently are in the direction of *alticola*, although the birds are still referable to *leucophoea*.

Specimens from the higher elevations within the Tropical Zone (to which the species is confined) have somewhat larger dimensions than birds from nearer the coast, but there is no clear division indicated and well over half the specimens fall within the same range of measurements.

Additional records assignable to *leucophoea* are from Callacate, Chepen, Paucal, and Tembladera.

In his "Trochilinarum enumeratio" (1855, p. 8 and pl. 777) Reichenbach became quite confused as to the identity of *leucophoea* and "*Amazilicula*." The latter name he used in 1853 for a bird (cf. synonymy of *A. a. dumerilii*) that he considered distinct from *leucophoea* by reason of its green tail. In 1855 he placed *leucophoea* in the synonymy of "*Amazilicula*" and referred to figures 4805-4806 of plate 777 where the two figures in question show *dumerilii*. At the same time he cited *dumerilii* and referred to figures 4803-4804 which illustrate a bird surprisingly like the then undescribed *alticola*, with the median rectrices green and the rest of the tail rufous, with dark margins on the feathers. Fortunately, none of the names was here published for the first time, so the confusion does not affect the nomenclature.

The line of separation between the range of *leucophoea* and that of the next form, *amazilia*, apparently lies between Huarmey and Huacho. There is a record of *amazilia* from Paucal, but the proximity of that locality to Chepen and Tembladera, well to the north of Huarmey, from both of which I have *leucophoea*, suggests that the record belongs with that form and not *amazilia*. Other records than those from which material has been examined are, then, Paucal and Callacate.

Amazilia amazilia amazilia (Lesson)

ornismya Amazilia Lesson, 1828, Manuel d'ornithologie, vol. 2, p. 81—environs of Lima, Perú.

Amazilia pristina GOULD, 1857, A monograph of the Trochilidae, vol. 5, [pt. 13] pl. 303 and text—neighborhood of Lima, Perú; cotypes in British Mus.

[*Amazilia*] *Lessoni* MULSANT, VERREAUX, AND VERREAUX, 1866, Essai d'une classification méthodique des trochilidés, p. 35—Perú.

Amazilia forreri BOUCARD, 1893, Humming Bird, vol. 3, p. 7—"Mazathan" [*errore* = western Perú]; Paris Mus.

This form, in which the extensive white pectoral patch of *leucophoea* is much reduced or wanting, occupies the coastal area of Perú from Huacho and Sayán south to Pisco and Ica. Birds from these southernmost localities show a slight approach toward *caeruleigularis* by reason of a little more bluish green on the anterior under parts and wider green tips on the central rectrices than in most other *amazilia*, although the latter character is matched by some examples from farther north. The extent of the white pectoral patch is variable, but this area is never so extensive as in *leucophoea* and in most cases is obsolete or represented only by pale margins on the green pectoral feathers.

All localities of record are included in the list of specimens examined except the generalized "Rimac Valley" in which some of these localities are situated.

Amazilia amazilia caeruleigularis Carriker

Amazilia caeruleigularis CARRIKER, 1933 (March 24), Proc. Acad. Nat. Sci. Philadelphia, vol. 85, p. 6—Nazca, Department of Ica, Perú; ♂; Acad. Nat. Sci. Philadelphia.

This well-marked subspecies is known only from the type locality. If any form of the species occurs on Mt. Misti (see account of *leucophoea*) it might well be this one whose range comes nearest to that mountain although still some distance away. It is

doubtful if any form of *amazilia* occurs on Misti. No collector has succeeded in finding one there since *leucophoea* was described, ostensibly from that volcano.

SPECIMENS EXAMINED

A. a. dumerilii.—

ECUADOR:

(Esmeraldas, Chongón Hills, Chone, Chongocito, Durán, Daule, Guayaquil, Salado, Manaví, San Martín, Naranjal, Isla de Puna, Cebollal, "W. Ecuador," "W. coast," and "Río Napo" [*errore*]), 22 ♂, 14 ♀, 2 ♀, 7 (?).

PERÚ:

Milagros, 1 ♂;
Paletillas, 3 ♂.

A. a. alticola.—

ECUADOR:

(Lunamá, Río Pindo, Portovelo, "Chongón," Casanga, Guainche, Loja, Zamora, Sabanilla, and "Ecuador"), 16 ♂, 5 ♀, 12 (?).

? PERÚ:

"Perú," 1 (?).

A. a. leucophoea.—

PERÚ:

Pacasmayo, 1 ♂;
Platanar, 1 ♂;
Tembladera, 2 ♂;
Alamor, 4 ♂, 1 ♀;
Chepen, 1 ♂;
Choquisongo, 6 (?);
Pucará, 1 ♂, 2 ♀;
Palambla, 4 ♂, 2 (?);
Chilaco, 1 ♂, 1 ♀;
Virú, 2 ♂, 7 ♀;
Poroto, 2 ♂, 1 ♀;
Somate, 2 ♀;
Sullana, 2 ♂;
Trujillo, 1 ♂, 6 ♀;
Talara, 2 ♂;
Huarmey, 1 (?);
Hacienda Llagueda, 1 ♂¹;
"Arequipa," 1 ♂ ("a type").

A. a. amazilia.—

PERÚ:

Huacho, 5 ♂, 5 ♀;
Sayán, 2 ♂;
Huaral, 7 ♂, 2 ♀;
Lima, 4 ♂, 1 ♀, 1 (?);

Specimens in Chicago Natural History Museum.

Vitarte, 1 ♂¹, 1 ♀ ;
Callao, 1 ♂¹;
Barranco, 1 ♂;
Pisco, 1 ♀ ;
Ica, 1 ♂, 1 ♀ ;
"Perú," 1 ♂, 1 ♂¹, 2 (?);
"Am. Cent." [*errore*], 1 (?);
no locality, 1 (?).

A. a. caeruleigularis.—

PERÚ:

Nazca, 1 ♂, 1 ♀ .

[*Amazilia versicolor millerii* (Bourcier)]

Trochilus millerii BOURCIER, 1847, Proc. Zool. Soc. London, pt. 15, p. 43—Rio Negro, Brazil.

Simon (1910, Rev. Française d'Ornith., vol. 2, p. 262) makes the puzzling statement that "*A. Milleri*" is recorded from Iquitos, but I can find no basis for this claim. It is not repeated in the "*Histoire naturelle des Trochilidae*" and may well have been a *lapsus calami*. At any rate, I know of no definite record of any form of *versicolor* from Peruvian territory.]

¹ Specimens in Chicago Natural History Museum.

AMERICAN MUSEUM NOVITATES

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NEW SPECIES OF *COPIDOGNATHUS* (ACARI, HALACARIDAE) FROM THE ALEUTIANS¹

BY IRWIN M. NEWELL²

The genus *Copidognathus* is well represented in the marine fauna of the Aleutian Islands and the Bering Sea, but only one species, *Copidognathus pseudosetosus* Newell, 1949, has been described from this region.

In the present paper four additional species are described, one of them being of considerable interest, not only because of certain unique structural characters, but also because it is related to species that are probably widespread in tropical and subtropical seas. The appearance of this group in subarctic waters in the form of *Copidognathus kagamili*, new species, was hardly to be expected.

This paper represents the first in a series of studies that will be devoted to the arctic Halacaridae, a research project being carried out with the generous assistance, financial and otherwise, of the Office of Naval Research and the Arctic Institute of North America. Most of the material was obtained by the writer during the summer of 1948 during the course of travels in the Aleutian Islands, Bering Sea, and Arctic Ocean, but additional material has been collected by others, especially Victor B. Scheffer of the United States Fish and Wildlife Service, Capt. Charles W. Thomas of the United States Coast Guard, and Gary and Helen Daetz of Kodiak, Alaska. The writer wishes to express his gratitude to these people for their assistance.

The standard abbreviations used in the monograph on the

¹ This study was made possible through aid provided by the Arctic Institute of North America and the Office of Naval Research.

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Halacaridae of eastern North America are used here for the following frequently recurring terms:

- AD, anterodorsal plate
- AE, anterior epimeral plate
- GA, genito-anal plate
- OC, ocular plate
- P-3, palpal segment three
- PD, posterodorsal plate
- PE, posterior epimeral plate
- I-6, segment six of leg I (or tarsus I)
- III-3, segment three of leg III (or femur three)

The figures were drawn by the author with the aid of a camera lucida. Scales are available for all figures, each subdivision of the scale representing $10\ \mu$, so that a scale with one division represents $10\ \mu$, one with three divisions represents $30\ \mu$, etc. In the scales that are 10 divisions long, a slightly longer mark has been made at the $50\text{-}\mu$ point.

The holotypes and some of the paratypes are in the collection of the American Museum of Natural History.

Copidognathus kagamili, new species

Figures 1-12

The following description is based on specimens from the type locality, Kagamil Pass, Islands of the Four Mountains, Aleutian Islands, Alaska.

FEMALE: Body $376\text{--}408\ \mu$ long by $201\text{--}246\ \mu$ wide, length/width = $1.66\text{--}1.87$; average $388.8\ \mu$ by $220.3\ \mu$, length/width = 1.77 (three specimens). Dorsum as described for male (fig. 2).

AE (fig. 3) almost completely smooth and devoid of pores and panels except for the two areas of rosette pores on each side just anterior and posterior to the insertion of leg II. These are typical rosette pores, with gaping ostia and prominent canaliculi. PE of each side also with two areas of rosette pores, otherwise smooth; lateral portion expanded and apparently flattened. GA with one small area of rosette pores on each side of the genital opening, and a few panels anterior to these; otherwise smooth. Chaetography unique in the presence of six to seven setae on each side of the genital opening rather than the usual three. Genital sclerites (fig. 4) with one pair of setae. Ovipositor very long, reaching nearly to anterior margin of GA. Membranous areas

greatly restricted, striae few, parallel, indistinct. Internal apodemes of AE very long, filamentous.

Tips of palpi (fig. 2) reaching to end of I-4, tip of rostrum (fig. 6) reaching to or nearly to end of P-2. Base of capitulum with deeply depressed porose panels with prominent canaliculi. Two large pairs of maxillary setae in addition to the two small pairs at the tip of the rostrum. Rostral sulcus (fig. 6) 0.52 to 0.61 as long as rostrum, average 0.57; first pair of long setae 0.00 to 0.18 of the length of the sulcus from the posterior end of the sulcus, average 0.04 (three males, two females).

In one female the following measurements were obtained (for I-3, I-5, II-3, II-5, the height is also given):

	1 + 2	3	4	5	6	AMBU- LACRUM	TOTAL
I	43 μ	102/41	33	97/32	76	24	375
II	41	72/33	26	70/26	73	29	311
III	65	68	27	81	96	33	370
IV	67	75	30	85	99	35	391

CHAETOTAXY

I				II				III				IV			
d.	v.	l.	m.	d.	v.	l.	m.	d.	v.	l.	m.	d.	v.	l.	m.
1	—	—	1	—	—	—	1	—	1	—	—	—	—	—	—
2	1	1	—	1	1	—	—	1	1	—	—	1	1	—	—
3	2	1	2	2	1	2	—	2	—	—	—	2	1	—	—
4	1	1	1	1	1	1	1	1	1	1	—	2	1	—	—
5	2	1	2	3	1	1	2	2	2	1	—	3	2	1	—
6 ^a	3	3	—	3	—	—	—	4	—	—	—	3 ^b	—	—	—

^a These figures do not include the bacillum or the parambulacral seta at the distal extremity of the tarsus. These are discussed separately in the text.

^b Rarely 4. See text.

Leg I when naturally extended about 0.81 times as long as body (three specimens). Femora I and II not swollen, 2.48 and 2.13 times longer than high. Chaetotaxy in male and female identical (figs. 9, 10, 11). I-3 and II-3 with panels which are elongated and partially subdivided (fig. 7); pores few in number, scattered, minute, and in no significant way influencing the general pattern of the cuticle. Median setae of I-5 and II-5 long, slender, appearing smooth at low magnifications, pectination visible only with oil immersion and with the most favorable optics, but nevertheless present. Parambulacral setae and bacillum normal for genus. III-3 with two dorsal and no ventral setae, IV-5 with

two dorsal setae and one ventral seta. III-3 and IV-3 paneled, but the panels less distinct than on I-3, the walls of the panels rugose. Distimedial seta of III-5 apparently smooth at magnifications below 800, but pectinations faintly visible at 1500 $\times$. Both III-6 and IV-6 with three setae dorsally, III-6 rarely with 4. Of eight males and six females examined, one male had four setae dorsally on III-6 of both sides, one female had four setae dorsally on III-6 of one side (other IV-6 missing), while all of the 22 third tarsi on the remaining 12 specimens had the usual three dorsal setae. However, this is a variation which must be kept in mind, not only in this species, but perhaps others as well. All tarsi with a prominent claw fossa. Median claw bidentate, the two teeth long, slender, tapering to a sharp point. All lateral claws with a delicate pecten and a prominent "accessory tooth." The latter, as the writer has pointed out in detail elsewhere (Newell, 1947, p. 104), is an illusion and does not represent a single tooth, but is simply the terminal portion of the J-shaped pecten as it appears in side view. No "accessory tooth" can be seen in a ventral view of the claw.

MALE: Body (fig. 2) 324-363 μ long by 181-207 μ wide, length/width = 1.66-1.79; average 340.9 by 195.7 μ , length/width = 1.74 (five specimens). AD with only two areas of pycnotic, greatly reduced rosette pores, the posterior one bearing the first pair of setae of the dorsal series, these being well behind the middle of the plate. Second pair of dorsal setae in OC. Corneae feebly developed, but the posterior cornea is normal for the genus, showing no sign of subdivision. Third pair of dorsal setae in PD. Costae of PD narrow but very distinct, and bearing a single row of pycnotic rosette pores (fig. 8). In a glycerine dissection of the female, a very narrow band of rudimentary rosette pores was seen on the margins of the plate as well, but this was not present in the glycerine dissection of the male, nor could it be detected readily in whole mounts of males or females in Hyrax. It was seen in one male rotated at an angle of 45° in Hyrax, however, so its presence must be considered variable. The costae themselves are also variable in extent, sometimes reaching to both ends of PD, sometimes reaching to only one or the other end. All dorsal plates prominently paneled (fig. 8).

Capitulum and legs as described for the female; no sexual dimorphism present. GA (fig. 1) roughly but faintly paneled, except in the area in front of the genital opening. An area of ro-

sette pores, these having gaping ostia, and intermediate in form between typical rosette pores and typical porose panels. Genital sclerites with four pairs of setae, the first and second of the same length, slender, tapering; third pair shortest and heaviest; fourth pair longest and slender. A small chitinous shelf behind the genital opening. Twelve or 13 setae on each side of the opening. Penis reaching nearly to anterior margin of plate. Adanal setae on dorsal surface of anal papilla, short, inconspicuous, not visible in ventral view.

REMARKS: This species is perhaps the most easily distinguishable *Copidognathus* in Alaska. Its slender body, long appendages, bold paneling of the dorsal plates, narrow costae with the pycnotic rosette pores, the posteriorly displaced setae of AD, and the long ovipositor reaching nearly to the anterior end of GA mark this unmistakably as the fourth member of that interesting group of species including *C. hummelincki* (Viets), 1936; *C. tricornata* (Lohmann), 1938; *C. adriatica* (Viets), 1940; and *C. kagamili*, new species. The last possesses a number of unusual characters, perhaps the most outstanding being the neotrichy exhibited by the female genito-anal plate. An examination of my specimens of *C. hummelincki* from Miami, Florida, shows that two females had four setae on one side and three on the other. In a third female, the second seta of AE had been duplicated on one side, so variations from the normal number of setae, on the ventral plates at least, appear to be common in this species. It should also be pointed out in connection with this that in *C. hummelincki* there are only three setae on PE, the one found at the level of the insertion of leg III in perhaps all other species of *Copidognathus* being absent. Lohmann's drawings of *C. tricornata* showed only one ventral seta on one side and two on the other (Viets, 1938, p. 131, fig. 4), but unfortunately these figures were only crude sketches, and no reliance can be placed on them. Furthermore nothing was said in the text concerning this character. *C. adriatica* is provided with the usual three ventral setae on PE, as is the case in *C. kagamili*, new species. The four species are separable as follows:

Copidognathus kagamili, new species: Second pair of dorsal setae in OC. GA of female with six to seven pairs of setae exclusive of those on the genital sclerites. Fifth pair of dorsal setae lateral to the costae. PE with four pairs of setae, three of these on the ventral surface. Ovipositor occupying about 85 per cent

of the interval between genital opening and anterior margin of GA. III-6 with four, IV-6 with three, setae dorsally. Aleutian Islands.

Copidognathus hummelincki: Second pair of dorsal setae in OC, but female with only the usual three pairs of setae on GA, or perhaps rarely four (in view of the variability noted above). PE with only three pairs of setae, two of these on ventral surface. Fifth pair of dorsal setae medial to the costae. Ovipositor occupying about 85 per cent of the interval between genital opening and anterior margin of GA. III-6 and IV-6 each with four setae dorsally. Caribbean Sea; southeast Florida.

Copidognathus adriatica: Second pair of dorsal setae not in OC but in the membranous area. Female with only the usual three pairs of setae on GA. PE with four pairs of setae. Fifth pair of dorsal setae lateral to the costae. Ovipositor occupying about 85 per cent of the interval between genital opening and anterior margin of GA. III-6 with four, IV-6 with three, setae dorsally (per Viets, 1940, p. 57, fig. 95). Adriatic Sea.

Copidognathus tricornata: Second pair of dorsal setae in membranous area. GA of female with only three pairs of setae. Chaetotaxy of PE and PD inadequately known. Ovipositor extending beyond the anterior margin of GA. III-6 and IV-6 each probably with four setae dorsally (Lohmann's sketch, published by Viets, 1938, p. 131, fig. 8, shows four dorsal setae on IV-6; in all other species thus far checked, when IV-6 has four dorsal setae, III-6 also has four). Southwest Pacific (Sydney).

The term "rostral sulcus" is introduced here for the first time, for preliminary studies by the writer show that the relative extent of this division between right and left halves of the tip of the rostrum will be of some systematic value. It is probably a relatively conservative character, being of roughly equal relative extent in closely related members of species groups. Certainly this is true in *C. kagamili*, new species, and *C. hummelincki*, for in both of these close relatives 95 to 100 per cent of the rostral sulcus is anterior to the first pair of long maxillary setae.

DISTRIBUTION: Kagamil Pass, Islands of the Four Mountains, Aleutian Islands, Alaska (latitude $52^{\circ} 56' N.$, longitude $169^{\circ} 44' W.$), female holotype at 245 feet depth. Boulder and gravel bottom covered with corals, sponges, and Hydrozoa. I. M. Newell.

***Copidognathus thomasi*, new species**

Figures 13-37

The following description is based on specimens from Rocky Point, Kuluk Bay, Adak Island, Alaska, the type locality.

FEMALE: A large species, with a body 616-680 μ long by 337-421 μ wide, length/width = 1.54-1.83; average 639.6 by 378.4 μ , length/width = 1.70 (10 specimens, measured to the tip of AD). AD (fig. 13) with three large circular areas of rosette pores (fig. 19), the posterior two coalesced. Setae anterior to the posterior groups of rosette pores. Second pair of setae of dorsal series in the membranous area between AD and OC. OC with one large group of rosette pores, enclosing two very feebly developed corneae, more readily visible in dissections in glycerine than in whole mounts in Hyrax, the corneae not joined. There are also two refractile spots or pores on the margin of OC behind the posterior cornea. Setae 3, 4, and 5 of the dorsal series are all enclosed within PD. The third pair is in the very margin of the plate but has never been found in the membranous area. Four rows of rosette pores present, the intervening spaces paneled (fig. 20), with numerous minute pores opening into the floor of the panels. Rosette pores not well developed, the ostia wide, and the canaliculi variable in size and distribution. Costae of PD slightly swollen just anterior to the fifth pair of dorsal setae. Striae of membranous area very delicate and numerous.

Ventral plates (fig. 15) almost completely covered with prominent depressed porose panels (fig. 18). These panels differ in their appearance at deep and shallow focus, appearing to be profusely and minutely pitted at shallow focus, but at deep focus a number of distinct canaliculi appear as shown in the figure. Typical rosette pores not developed, but some of the porose panels lateral to the genital opening are quite deep. AE with three pairs of setae; PE with three setae ventrally and one dorsally. GA with the usual three pairs of long setae; a pair of small setae on the genital sclerites, and a second pair on the anal papilla. Ovipositor very short, scarcely reaching beyond the anterior end of the genital opening (fig. 15).

Capitulum (fig. 17) with two large and two small (fig. 16) pairs of maxillary setae, the proximal pair being posterior to the insertions of the palpi. Tip of rostrum reaching to end of P-2. Palpi and chelicerae as shown in figures 23 and 24. Base of capitulum covered with depressed porose panels.

Rostral sulcus 0.66 to 0.72 as long as rostrum, average 0.69; first pair of long maxillary setae 0.34 to 0.38 of the length of the sulcus from the posterior end of the sulcus, average 0.36 (three males, three females).

In one female the following measurements were obtained (for I-3, I-5, II-3, II-5 the height is also given):

	1 + 2	3	4	5	6	AMBU- LACRUM	TOTAL
I	62 μ	152/72	50	145/44	93	33	535
II	81	137/59	46	128/43	110	38	540
III	114	129	52	139	131	38	603
IV	122	146	52	143	134	55	652

CHAETOTAXY

I				II				III				IV			
d.	v.	l.	m.	d.	v.	l.	m.	d.	v.	l.	m.	d.	v.	l.	m.
1	—	—	1	—	—	—	1	—	1	—	—	—	—	—	—
2	1	1	—	1	1	—	—	1	1	—	—	1	1	—	—
3	3	1	1	3	1	1	—	2	—	—	—	2	1	—	—
4	1	1	1	1	1	1	1	2	1	—	—	2	1	—	—
5	3	1	1	3	1	1	2	2	2	1	—	2	2	1	—
6	3	3	—	3	—	—	—	4	—	—	—	3	—	—	—

Leg I (fig. 21), when naturally extended, about 0.65 to 0.75 times as long as the body (4 specimens). Femora I and II not swollen, 2.11 and 2.32 times as long as high, no lamellae present, prominently paneled, the panels profusely marked with minute cuticular canals (fig. 26). Remainder of segments of legs I and II with numerous canaliculi, but paneling only feebly developed at most. Medial setae of I-5 distinctly pectinate and, as is the ventral seta (fig. 27), guarded at the base by a projection of the cuticle (fig. 28). I-6 with the usual three dorsal and three ventral setae in addition to the bacillum and the divaricate parambulacral setae. The distiventral setae are closely applied to the end of the tarsus. Bacillum on lateral membrane of the moderately developed claw fossa. Just anterior to the bacillum is apparently a rudimentary alveolus (dotted structure in fig. 29), provided with a cuticular canal, and evidently the homologue of the prebacillum. No seta is evident, however. Median claw well developed, bidentate; lateral claws pectinate, and with an apparent "accessory tooth." Leg II like I except for the differences noted in the tables. Also the cuticular processes at the bases of the ventral and medial setae of II-5 are not so well developed as those on I-5, and the

prebacillar rudiment on I-6 is absent. Divaricate parambulacral setae present as on I-6. III-1, IV-1, III-3, and IV-3 moderately paneled, and other segments distinctly porose. III-3 with no ventral seta. Ventromedial seta of III-5 very heavy and faintly pectinate. In addition to the four dorsal setae of III-6 (fig. 22), there are the parambulacral setae, the lateral one rather bacilli-form, long, reaching to the end of the median claw, the median one shorter, stouter, and possibly palmate. IV-5 with distimedial seta elongate, smooth, not pectinate. IV-6 with both parambulacral setae stout; only three dorsal setae.

MALE: Resembling the female in nearly all respects noted above, except structure of GA. Body somewhat smaller, 590–629 μ long by 337–389 μ wide, length/width = 1.62–1.83; average 611.1 by 349.9 μ , length/width = 1.75 (7 specimens). Distidorsal setae of III-3 faintly pectinate, but chaetotaxy of legs and capitulum essentially identical in male and female; posterior maxillary setae in same position in both sexes.

GA (fig. 14) like that of the female in outline, differing chiefly in the form of the genital opening and the chaetotaxy. Genital opening surrounded by about 50 long, slender setae (fig. 25); genital sclerites with the usual four pairs of setae, the anterior two pairs long and reaching to or nearly to the ends of the genital sclerites. Rosette pores absent, but cuticle marked with prominent porose panels of a complex nature, as in the case of the female. At low focus there are a number of discrete canaliculi in each panel (fig. 30), but the external ends of the canaliculi appear to be branched or distorted. The panel indicated by the arrow in figure 30 has been redrawn separately in figure 31 in which the deep focus image is represented by the seven dotted circles, while the shallow focus image is shown in solid black. Finally, the canaliculus indicated by the arrow in figure 31 has been drawn at several different levels below the surface of the cuticle (figs. 32 to 37), showing its approximate appearance in glycerine at six levels (0, 1, 2, 3, 4, 5 μ). While their small size and diffraction images obtained make it difficult to study and interpret these canaliculi, it is evident that their openings are either multiple or enlarged, and usually both types of modification are found in a single panel. The canaliculi appear larger in Hyrax preparations than in glycerine, doubtless owing to differences in relative refractive indices of mountant and cuticle.

REMARKS: This species is named for Capt. Charles W. Thomas,

commanding officer of the United States Coast Guard Cutter "Northwind" during that ship's Arctic cruise of 1948. It was his sincere interest in marine biology and oceanography that enabled me to procure valuable deep-water collections in the Arctic Ocean, Bering Sea, and Gulf of Alaska. Several of these were obtained by Captain Thomas himself after the writer had left the ship.

This species is one of the largest in the genus and is over half again the size of the largest species seen to date by the writer.

DISTRIBUTION: Rocky Point, Kuluk Bay, Adak Island, Alaska (latitude $51^{\circ} 51' N.$, longitude $176^{\circ} 36' W.$). Intertidal, on mixed red algae. I. M. Newell.

Copidognathus punctatus, new species

Figures 39-54

The description is based on specimens from Rocky Point, Kuluk Bay, Adak Island, Alaska, the type locality.

FEMALE: Body (fig. 42) as in male, $382-434 \mu$ long by $227-253 \mu$ wide, length/width = $1.64-1.80$; average 410.2μ by 236.5μ , length/width = 1.74 (nine specimens). Sides and posterior margin of AD relatively straight; a pair of prominent pores just anterior to the setae. Second pair of setae of dorsal series in the membranous area between AD and OC. OC with a pore and a transversely oriented refractile spot posterior to the irregular and sometimes indistinct corneae. Setae 3, 4, and 5 of dorsal series all in PD. Costae absent, but lateral portions of plate usually deflected downward sharply, forming a distinct line, but this is always lateral to the setae, whereas true costae are medial to the setae. All dorsal plates profusely and uniformly marked with minute cuticular canals (fig. 39); paneling sometimes feebly developed, but more often absent. Membranous areas restricted, marked with prominent parallel striae which only rarely anastomose.

GA elongate, nearly parallel sided, the three pairs of long setae all well behind the middle of the plate. Genital opening displaced far posteriorly, the tips of the genital sclerites reaching beyond the anus (fig. 43). AE (fig. 42), PE, and GA completely devoid of rosette pores, uniformly canaliculate like AD and PD, paneling feebly developed when present. PE with three ventral setae and one dorsal.

Tip of rostrum (fig. 51) not reaching to end of P-2. Two pairs of large maxillary setae, and two pairs of small ones near the end of the rostrum. Base of capitulum and most of rostrum minutely punctate. Rostral sulcus 0.65 to 0.77 as long as rostrum, average 0.73; first pair of long maxillary setae 0.39 to 0.62 the length of the sulcus from the posterior end of the sulcus, average 0.50 (two males, three females). Legs as in male.

MALE: Resembling the female in most respects except the characters of GA. Body (fig. 38) 408–415 μ long by 220–246 μ wide, length/width = 1.66–1.85; average 410.2 by 235.2, length/width = 1.75. GA (figs. 50, 54) of same relative extent as in female, but genital opening not displaced so far posteriorly, and surrounded by about 12 setae on each side. Genital sclerites with the usual four pairs of setae, the anterior two pairs somewhat more slender and tapering than the last two which are spiniform. Cuticle as described for the female (figs. 39, 40). Capitulum (fig. 41) as described for female, except that the posterior maxillary setae are relatively farther from the base of the palp (two specimens). Palpi and chelicerae as shown in figures 47 and 53.

In one male the dorsal lengths of the various leg segments were as follows (for I-3, I-5, II-3, II-5, the height is also given):

	1 + 2	3	4	5	6	AMBU- LACRUM	TOTAL
I	44 μ	68/43	27	70/26	41	17	267
II	46	62/35	24	56/27	50	24	262
III	67	56	26	62	58	26	295
IV	70	58	26	60	56	26	296

CHAETOTAXY

				II				III				IV			
				d.	v.	l.	m.	d.	v.	l.	m.	d.	v.	l.	m.
1	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—
2	1	1	—	—	1	1	—	—	1	1	—	—	1	1	—
3	3	1	1	—	3	1	1	—	2	—	—	—	2	—	—
4	1	1	1	1	1	1	1	1	1	1	—	2	1	—	—
5	2	1	2	2	3	1	1	2	2	2	1	—	2	2	1
6	3	3	—	—	3	—	—	—	4	—	—	—	3	—	—

Leg I, when naturally extended, about 0.58 to 0.62 times as long as body (three specimens). Femora I and II swollen, only 1.59 and 1.77 times as long as high, no lamellae or keels present, paneling feebly developed, the panels small when present. Cuticle of leg segments minutely canaliculate (fig. 48), the canaliculi

smaller than those on the body plates. Ventromedial setae of I-5 and II-5 pectinate, also the seta on III-5 (figs. 45, 44, 46).

Positions of pectinate setae of I-5 and II-5 somewhat variable, but usually as shown in the figures. Chaetotaxy of I-6 and II-6 typical for the genus, and as described for *Copidognathus thomasi*, new species, except that no rudimentary prebacillar alveolus was found. III-3 and IV-3 with only two setae, these dorsal in position. In all favorably oriented specimens, two setae were found on III-3, but in some that were not so favorably oriented, only one was found. However, one of the setae is so small (fig. 46) that it might easily escape detection. Its alveolus is considerably smaller than usual, also, making it doubly difficult to find. III-6 with four, IV-6 with three, setae dorsally. Parambulacral setae of III-6 (fig. 52) differing considerably in form, the medial one slender, bacilliform, the lateral one much shorter, spiniform, and pectinate (ventral view, fig. 49). On IV-6, both parambulacral setae are flattened and coarsely pectinate; this is also true of the female. All tarsi with fossa and lateral membranes, all claws distinctly pectinate and with an apparent "accessory tooth." Median claws small, bidentate.

REMARKS: This species varies appreciably in the degree of development of the paneling, some individuals appearing completely unpaneled, while in others paneling is clearly evident, although never prominent as, for example, in *Copidognathus thomasi*, new species. Both sexes show this variability.

DISTRIBUTION: Rocky Point, Kuluk Bay, Adak Island, Alaska (latitude 51° 51' N., longitude 176° 36' W.). Intertidal, on mixed red algae. I. M. Newell.

Copidognathus parapunctatus, new species

Figure 38

This species is very similar to *Copidognathus punctatus*, new species, in many respects, and for a while the writer had considered it a simple variant. However, close study shows that there are a number of consistent differences between these two forms, and once these have been detected, the two species can be separated quickly and with certainty. Only a brief diagnosis will be given here, pointing out the critical characters which can be used to differentiate the new species from *C. punctatus*.

AD marked with widely spaced porose panels, not uni-

formly punctate. Dorsal plates usually, if not always, closer together than in *C. punctatus*. I-3 and I-5 more heavily paneled, relatively shorter and higher, I-5 and II-5 more distinctly clavate than in *C. punctatus*. Dorsal setae of III-6 always more widely separated, the distance from the base of the tarsus to the first seta between one and two times as great as the distance from the first seta to the second. In *C. punctatus* (fig. 46), the ratio of these respective distances is about 3:1 and usually greater.

DISTRIBUTION: Attu Island, Alaska, 1.5 miles northeast of Alexai Point, female holotype. Intertidal, on red algae. I. M. Newell.

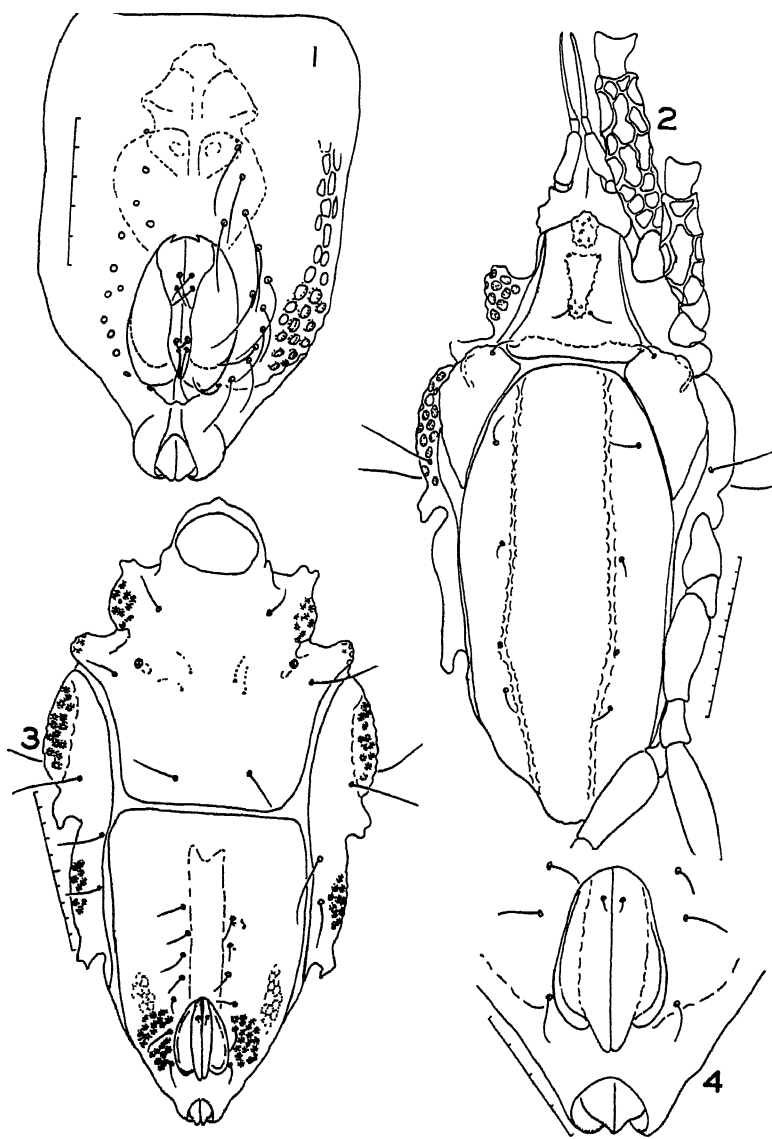
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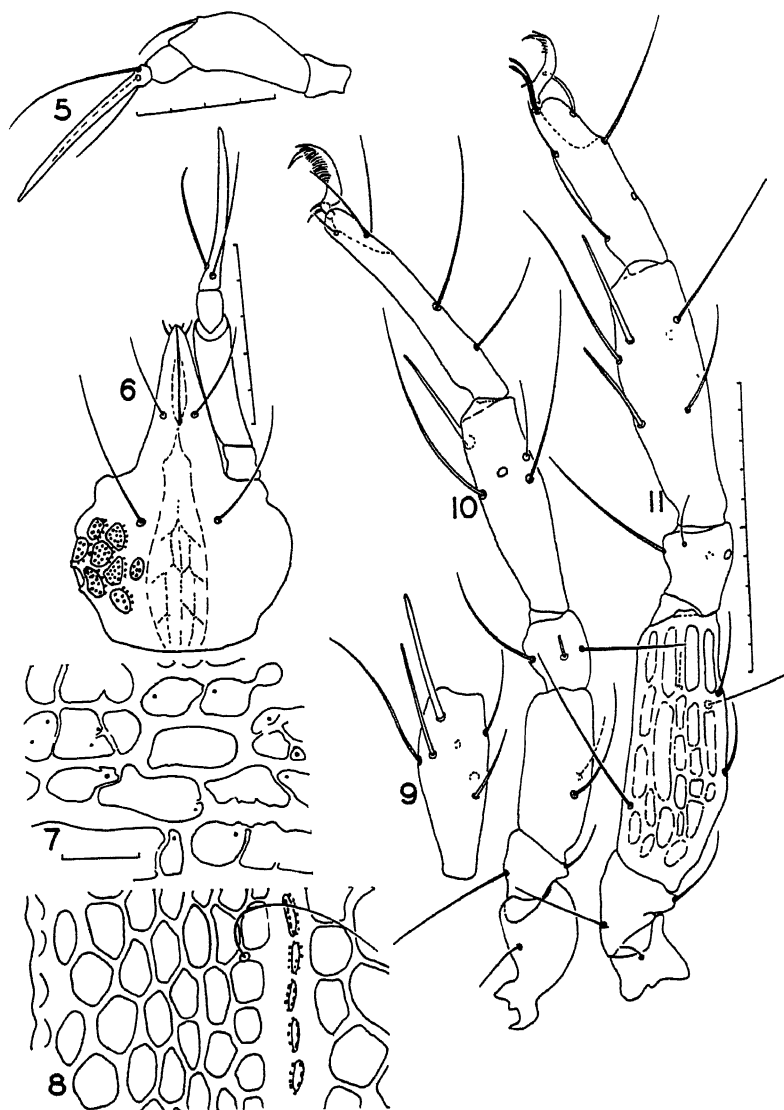
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- 1940. Meeresmilben aus der Adria. (Halacaridae und Hydrachnellae, Acari) Arch. Naturgesch., new ser., vol. 9, pp. 1-135.



FIGS. 1-4. *Copidognathus kagamili*, new species. 1. Male, G.A. 2. Male, dorsum. 3. Female, venter. 4. Female, genital area.



FIGS. 5-11. *Copidognathus kagamili*, new species. 5. Female, palp. 6. Female, capitulum. 7. Female, paneling on I-3. 8. Male, PD at level of left fourth dorsal seta, same scale as figure 7. 9. Male, II-5, medial view, same scale as figures 10 and 11. 10. Male, leg III, lateral. 11. Male, leg I, medial.

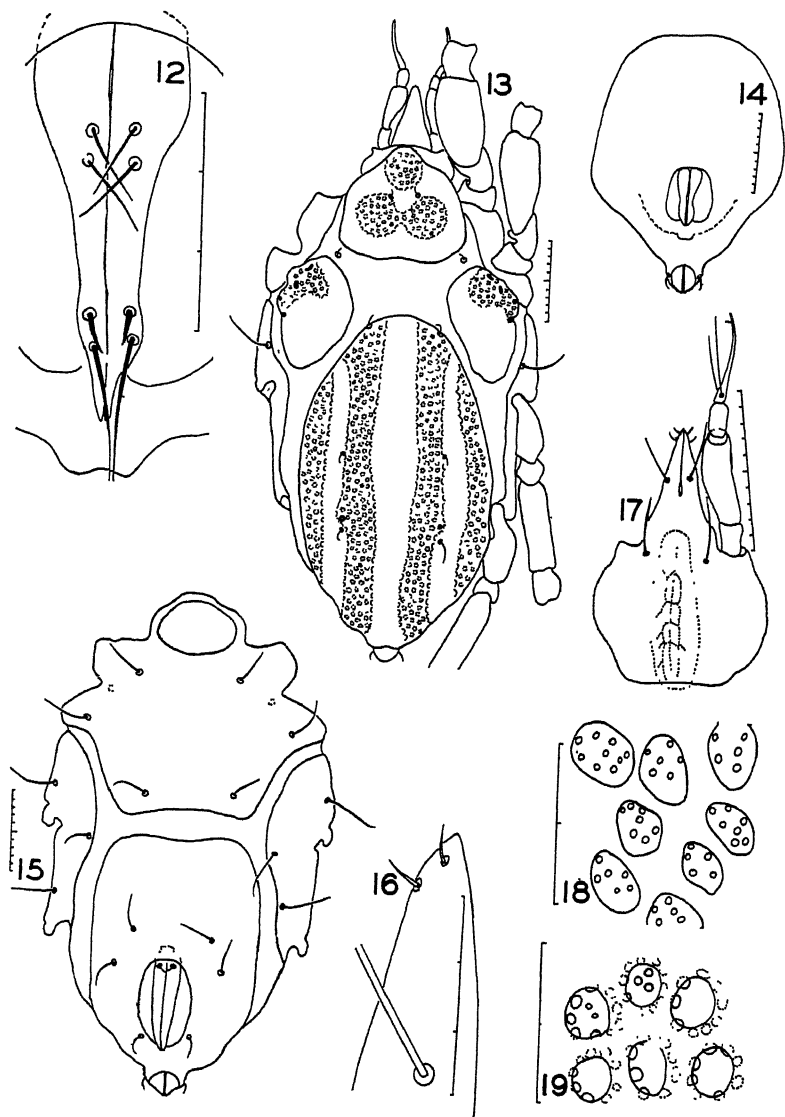
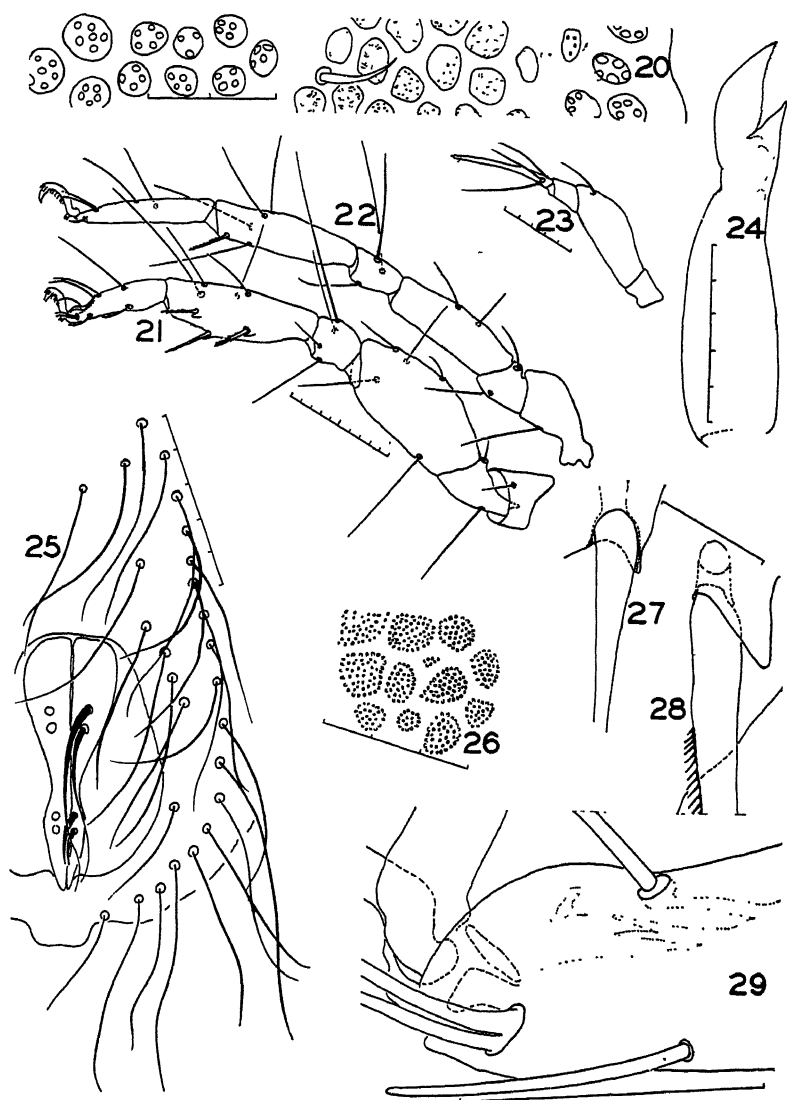
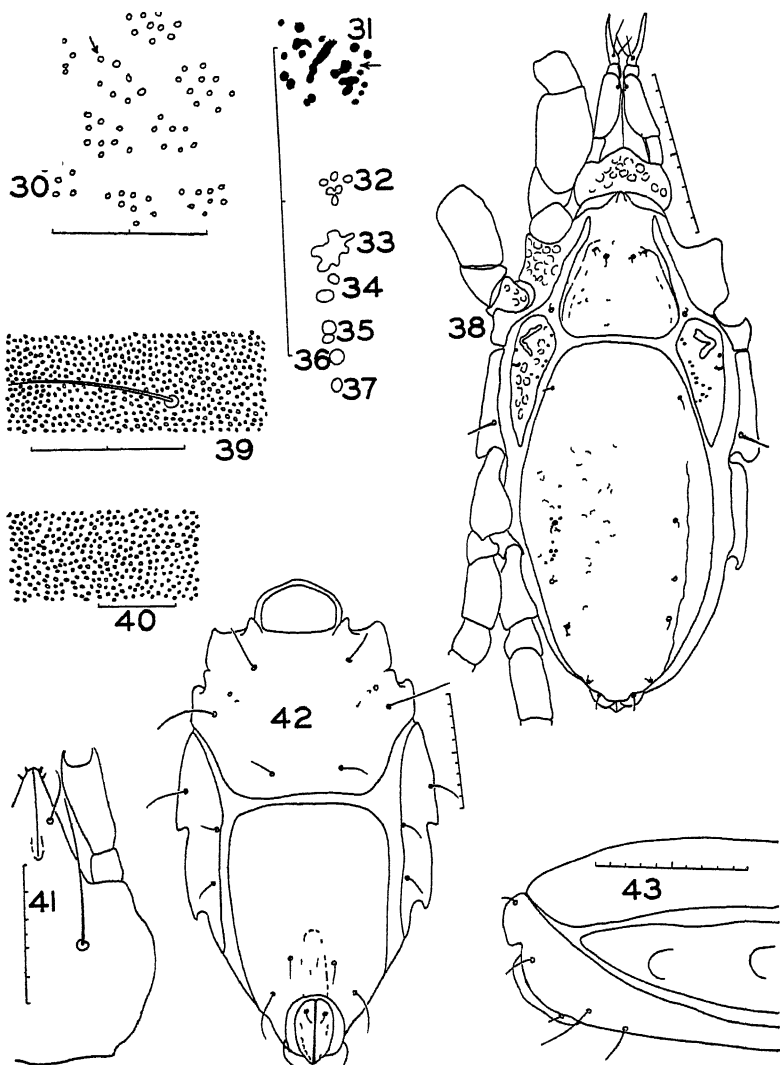


FIG. 12. *Copidognathus kagamili*, new species. Male, genital opening.

FIGS. 13-19. *Copidognathus thomasi*, new species. 13. Female, dorsum. 14. Male, GA. 15. Female, venter. 16. Female, right half of tip of rostrum, ventral view. 17. Female, capitulum, ventral view. 18. Female, porose panels near middle of AE. 19. Female, rosette pores of AD.



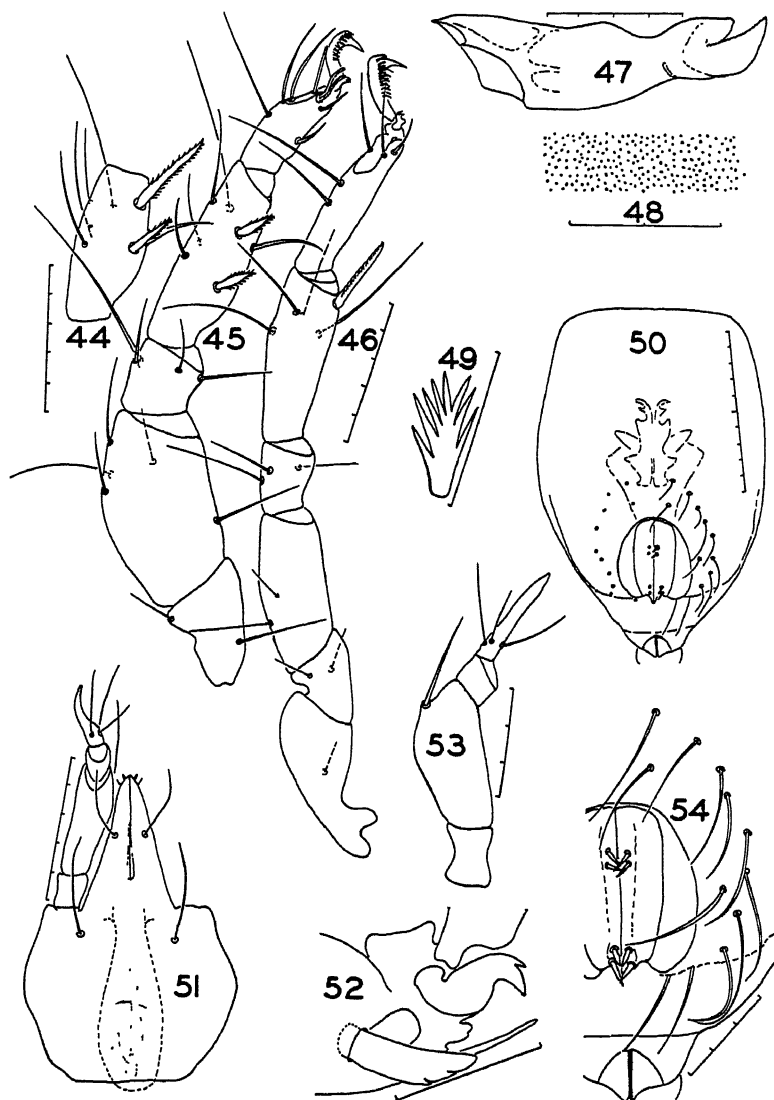
FIGS. 20-29. *Copidognathus thomasi*, new species. 20. Female, PD at level of fourth dorsal seta. 21. Female, leg I, medial view. 22. Female, leg III, medial view, same scale as figure 21. 23. Female, palp, medial view. 24. Female, chelicera. 25. Male, genital area. 26. Female, porose panels of I-3. 27. Female, ventral seta of I-5. 28. Female, posterior medial seta of I-5. 29. Female, II-6, lateral view.



FIGS. 30-37. *Copidognathus thomasi*, new species. 30 Male, porose panels of GA at deep focus. 31 Male, porose panel indicated by arrow in figure 30, explanation in text. 32-37 Male, pore indicated by arrow in figure 31, drawn at progressively deeper focus, explanation in text.

FIG. 38. *Copidognathus parapunctatus*, new species. Male, dorsum.

FIGS. 39-43. *Copidognathus punctatus*, new species. 39. Female, cuticular detail at level of fourth dorsal seta. 40. Female, AE near middle of plate. 41. Male, capitulum, ventral view. 42. Female, venter. 43. Female, lateral view of end of body.



FIGS. 44-54. *Copidognathus punctatus*, new species. 44. Male, II-5. 45. Male, leg I. 46. Male, leg III. 47. Male, chelicera. 48. Male, cuticular details, I-3. 49. Female, medial parambulacral seta of III-6, ventral view. 50. Male, GA. 51. Female, capitulum, ventral view. 52. Male, III-6, lateral view. 53. Male, palp. 54. Male, genital area.

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THE BLISTER BEETLES OF NORTH CENTRAL MEXICO (COLEOPTERA, MELOIDAE)

By PATRICIA VAURIE¹

INTRODUCTION

This is one of a series of papers on the insects collected on the Mexican plateau in the summer of 1947 on the David Rockefeller expedition to north central Mexico (see Spieth, Herman T., 1950, "The David Rockefeller Mexican Expedition of the American Museum of Natural History, Introductory account," Amer. Mus. Novitates, no. 1454).

The family Meloidae was well represented in the region covered by the expedition (Chihuahua, Coahuila, Durango, and Zacatecas), 45 species of 12 genera having been taken. There are 22 additional species reported by Champion in the "Biologia Centrali-Americana" (vol. 4, pt. 2) as occurring in this area.

The collection amassed by the expedition has enlarged the northward or southward range of nearly every species since, aside from the four or five localities in which some of the early collectors worked, this north central area has been virtually untouched until recent years. Eighteen of the species collected are here recorded for the first time in the four above states: *Zonitis megalops*, *piezata*; *Gnathium minimum*; *Epicauta andersoni*, *atrivittata*, *callosa*, *fortis*, *hirsutipubescens*, *linearis*, *longicollis*, *normalis*, *polingi*, *sericans*, *tenella*; *Pleuropompha costata*, *tricastata*; *Tetraonyx frontalis*; *Pyrota quadrinervata*. The occurrence of half of these species in the southwestern United States would presuppose their occurrence also south of the border. The others either had a more southern range or the present material

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has filled in a distributional gap that formerly existed. Six of these species have been described since 1934 and so could not have been included in the "Biologia," which is about the only reference for the distribution of Mexican species.

Champion's colored figure of *Pleurospasta mirabilis*, a species that he reported in the "Biologia" as from Coahuila, has been found to represent not that species but *P. reticulata* Van Dyke, which is discussed later.

Twenty-one of the 67 species occurring in this plateau region of north central Mexico have not been taken in the United States. Some of these may be Neotropical in origin and reach the northern limit of their range south of the border; some have been described and are known from one locality only; and some may yet prove to be synonyms of United States species. This leaves two-thirds of the species occurring both in the southwestern United States and on the north central Mexican plateau, which comprise, of course, virtually the same region. Only 25, or a little more than a third, of the 67 species continue into southern Mexico, a few being found as far south as Yucatan, Guatemala, or Costa Rica.

Ten of the species have been taken in Sonora, but unfortunately few actual Sonoran localities have been given, so that it is impossible to tell whether these species occur to the east or to the west of the Sierra Madre Occidental which cuts through the eastern part of Sonora. In most cases it would be correct to suppose that they occur to the east of the Sierras since the north central Mexican plateau is continuous faunistically with the eastern Arizona, New Mexico, and the western Texas area. *Epicauta normalis*, however, has been taken in the United States not only in eastern Arizona, but also in southern California, and it would be of interest to know whether or not it moves south into western Sonora as well as south into Chihuahua and eastern Sonora.

Seven species have been reported from the eastern border of the Mexican plateau, at Monterrey in Nuevo León. Two species (*Epicauta segmenta*, *corvina*) have been taken on the western coast of Mexico in the state of Sinaloa.

Included in this study and in the keys are all the species reported by Champion as coming from Chihuahua, Coahuila, Durango, and Zacatecas, whether specimens were available or not. Species reported from the other northern states (Sonora, Sinaloa, Nuevo León, Tamaulipas) were not included unless they occurred also in the above region.

The determination of a number of species about which there was some doubt was kindly made by Floyd G. Werner. These were *Epicauta callosa*, *ferruginea*, *fortis*, *hirsutipubescens*, *lauta*, *linearis*, *polingi*, *sericans*, *stigmata*, and *Lytta quadrimaculata*.

The order of the genera was taken from Denier's revision (1935) which appears also in Blackwelder's two catalogues (1939, 1945); the only changes made were in the genera synonymized by Werner (1945). The *Epicauta* have been arranged according to Werner (1945), with the Mexican species inserted according to Champion. In *Pyrota*, Denier (1934) was followed; in *Lytta*, Champion (1892, under *Cantharis*); in *Meloe*, Van Dyke (1928); in *Zonitis*, Champion (under *Zonitis* and *Nemognatha*).

The localities listed under the recorded distribution of each species are taken from Champion unless otherwise stated. Some of them could not be found, some are ambiguous in that they might be the city or the state of the same name, and some (common names which occur in many states) are of little value because they are not located as to the state. The only locality which was accepted without a state name is the well-known Jalapa of Vera Cruz. Too much reliance cannot be placed on the ranges given by Champion, as they may actually include more than one species.

In order to avoid unnecessary repetition of collectors' names and to simplify the listing of specimens, much of the data on the expedition material has been omitted under the species, but it is presented in tabular form below for reference. Such data, however, from other American Museum specimens examined is given in full in the text. A small amount of material collected by Mr. and Mrs. George Bradt has also been included in this study.

I am indebted to Dr. Mont A. Cazier for his patience in reading this manuscript and for his suggestions of many improvements; to Mr. Floyd G. Werner also for reading the manuscript and for the identification of some specimens; and to Dr. J. Balfour-Browne of the British Museum for comparison of *E. callosa* with the type of *E. candidata*. Thanks are also due to Miss Alice Gray for the genitalic drawings of *Pleurospasta reticulata* and *P. mirabilis*.

EXPLANATION OF MAPS

The letters on the maps correspond to the names of the localities given in the text. The recorded distribution is shown by solid circles; new localities (whether from the 1947 expedition or from

DATA ON SPECIMENS FROM THE DAVID ROCKEFELLER
MEXICAN EXPEDITION

LOCALITY	ALTITUDE IN FEET	DATE
Chihuahua		
Balleza	5200	July 21
Camargo	4900	July 14, 15
Catarinas	5800	July 25, 26
Chihuahua	4600	June 30
Ciudad Juárez	3700	July 1
Delicias	4150	July 11, 13
La Cruz	4000	July 13
Madera	7200	July 6
Matachic	6400	July 7
Ojo Laguna	5000	June 30
Parral	5500	July 15, 16
Parrita	5600	June 27
Primavera	5500-6000	June 30
Samalayuca	4360	June 24
San José Babicora	7100	July 5
Santa Bárbara	6300	July 17, 18
Santa Clara	5000-6000	July 2
Valle de Olivos	5500	July 20
Coahuila		
Cabos	4000	August 21
Guadalupe	3100-3500	August 23
La Gloria	3300	August 24
La Rosa	5300	August 22
Paila	3900	August 21
Piedras Negras	1300	August 25
Saltillo	5100	August 22
San Pedro de Colonias	3700	August 20
Durango		
Coyotes	8300	August 8
Durango	6200	August 14
El Salto	8500	August 10
Encino	6200	July 27
Las Puenteas	7000	July 24
Nombre de Dios	5900	August 13
Otinapa	8200	August 11
Palos Colorados	8000	August 5
Pedricena	4500	August 19
San Juan del Rio	5200	July 30-August 1
San Lucas	6700	August 2
Villa Madero	6700	August 18
Yerbanís	6700	August 19
Zacatecas		
Fresnillo	7000	August 15
Guadalupe	7400	August 16

Collectors: Mont A. Cazier, Willis J. Gertsch, Charles D. Michener,
Rudolph Schramel, and Herman T. Spieth

other specimens at the American Museum of Natural History) are indicated by crosses. For species seen or reported from Sonora a question mark has been used to indicate lack of adequate locality. The arrows show that the species occurs or is said to occur in Arizona, New Mexico, Texas, or Guatemala.

CLASSIFICATION

KEY TO THE GENERA OF MELOIDAE IN NORTH CENTRAL MEXICO

1. Front femora on inner side with an excavation at middle or near apex that is usually filled with silky patch of contrasting golden hairs turned at an angle from other hairs on femora.....²
Front femora on inner side without excavation or such a patch of hairs 3
2. Elytra strongly costate.....*Pleuropompha*
Elytra not costate, or with three fine, slightly elevated lines.....*Epicauta*
3. Tarsal claws cleft to base with serrations on upper blade; maxillae prolonged beyond the mandibles..... 4
Tarsal claws either cleft to base without serrations on upper blade, or claws with distinct tooth; maxillae not prolonged beyond the mandibles..... 5
4. Thorax with hind angles prominent; antennae with segments 5 to 10 twice or more than twice as long as wide; head at base much wider than the space between the eyes.....*Zonitidis*²
Thorax with hind angles indistinct, not prominent, and rounded beneath; antennae with segments 5 to 10 only one-third longer than wide; head at base not wider than the space between the eyes.....*Gnathium*²
- 5.(3). Head deeply sulcate from base to apex; head red, elytra bright green....
.....*Eupompha*
Head, if at all sulcate, not sulcate from base to apex; coloring not as above.
..... 6
6. Claws cleft to base, not toothed..... 7
Claws not cleft to base, but strongly toothed, tooth shorter than claw 10
7. Elytra overlapping at suture immediately behind scutellum, elytra divergent; scutellum slightly or not evident.....*Meloe*
Elytra not overlapping at suture immediately behind scutellum, elytra not divergent; scutellum well developed..... 8
8. Thorax strongly transverse, twice as broad as long, hind angles sharp, prominent.....*Tetraonyx*
Thorax either longer than broad, or rounded, or hexagonal, not transverse, hind angles rounded, not prominent..... 9
9. Thorax much longer than broad, usually bell shaped, narrowed at apex and often with transverse depression near apex; antennal segments decreasing in thickness to apex, slender, filiform (almost bead-like in *quadrinervata*).....*Pyrota*
Thorax scarcely longer than broad and either rounded or hexagonal; an-

¹ In four species (*Epicauta callosa*, *ferruginea*, *fortis*, *sericans*) this character, though present, is weak, the silky hairs being not so sharply delimited and being the same color as the other hairs on the femora.

² See discussion under the genus.

- tennal segments increasing in thickness to apex (female), or 3 to 6 greatly enlarged (male), segments robust, bead-like.....*Lytta*
10. (6). Elytra costate; winged species.....*Pleurospasta*
 Elytra not costate; wingless species.....11
11. Elytra large, entire, united along suture, covering all but the extreme apex of the abdomen.....*Cysteodemus*
 Elytra small, abbreviated, divergent, usually covering only small part of the enlarged abdomen.....*Megetra*

GENUS ZONITIS FABRICIUS

Zonitis FABRICIUS, 1775, *Systema entomologiae*, p. 126.

Apalus OLIVIER, 1789, *Encyclopédie méthodique*, vol. 4, p. 165.

Nemognatha ILLIGER, 1807, *Mag. für Insektenk.*, vol. 6, p. 333.

Megatrachelus MOTSCHULSKY, 1845, *Bull. Soc. Imp. Moscou*, vol. 18, p. 1, pp. 83-84.

Nematognatha GEMMINGER AND HAROLD, 1870, *Catalogus coleopterorum*, vol. 7, p. 2163.

Although he retained *Nemognatha* as a separate genus, Champion (1892, p. 373) stated that the sole character separating it from *Zonitis*, the longer maxillae, failed to hold in a transition species he was describing. Casey (1891, p. 170) had already considered the two congeneric, and Denier (1935, p. 135, and footnote 13) supported him by suppressing *Nemognatha*, though he did so provisionally. Blackwelder's two catalogues (1939, 1945) follow Denier.

There are 24 species of *Zonitis* and *Nemognatha* recorded by Champion, three of which he reported from the region covered in this paper (*zonitoides*, *lurida*, *immaculata*) and two of which were found in the material collected in 1947 (*lutea*, *megalops*). This group, however, is in such a chaotic condition taxonomically that the attempt to identify the majority of specimens was abandoned, and even the above five species are here offered with reservations.

One of these species, *megalops*, is worthy of further mention as it possesses certain seemingly fundamental differences from others of the genus: the eyes nearly touching under the head and but narrowly separated above, and the antennae nearly as long as the body and exceedingly attenuate. These characters might warrant placing *megalops* in a separate genus, but to do this would mean further study of other genera in the same tribe as *Zonitis* and the examination of much additional material from other parts of the world, and this is beyond the scope of the present paper. Specimens with the same eye and antennal characters as *megalops* (Guatemala, north central Mexico) have been examined, not only

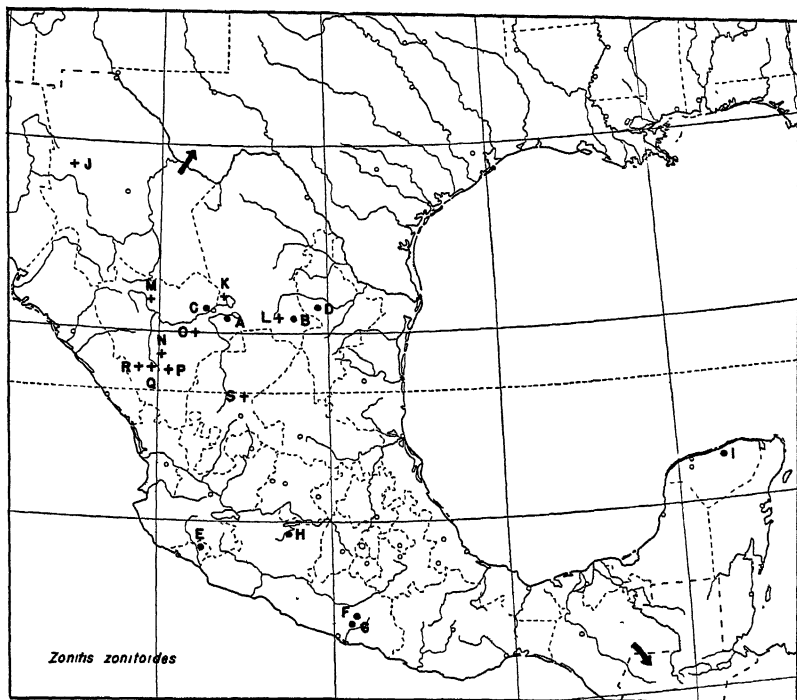


FIG. 1. Distribution of *Zonitis zonitoides* (Dugès).

from California, Arizona, and Florida in the United States, but also (a subspecies ?) from Puerto Rico, Haiti, and the Dominican Republic and a different species from Papua, New Guinea. (See further discussion under *megalops*.)

Instead of a key to *Zonitis*, a short description of essential characters has been given at the end of each species.

Zonitis zonitoides (Dugès)

Figure 1

Nemognatha zonitoides DUGÈS, 1877, La Naturelle, vol. 3, pp. 47-48, pl. 2 fig. 1.

TYPE LOCALITY: Guanajuato.

RECORDED DISTRIBUTION: *Mexico*. Coahuila: San Pedro [not located], Parras (A), Saltillo (B). Durango: Villa Lerdo (C). Nuevo León: Monterrey (D). Guanajuato. Colima: Tonila (E). Guerrero: Chilpancingo (F), Rincón (G). Michoacán: Morelia (H). Yucatán: Temax (I). *Guatemala*: San Jerónimo.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: 2 miles west of Matachic (J), one. Coahuila: San Pedro de Colonias (K), one; La Rosa (L), one. Durango: Encino (M), three; San Lucas (N), 17; Yerbánis (O), Cuencamé District, one; Durango (P), three; Palos Colorados (Q), one; Otinapa (R), one. Zacatecas: Fresnillo (S), two.

OTHER SPECIMENS EXAMINED: *Guatemala*: San Jerónimo (Champion), two.

Champion (1892, p. 379) says that this species is quite variable in coloration, and the above material supports his statement. Ten specimens have the thorax more or less clear yellow, while 16 have it yellow with vague piceous spots in the center and on each side of the center, five have the thorax well marked with two elongate spots as described by Dugès. In nine specimens the abdomen is partially or entirely yellow instead of black. A few have the front of the scutellum suffused with yellow. Champion mentions some with yellow legs, but all the above specimens have black legs. The color variations do not seem to be correlated with geographical distribution.

DESCRIPTION: Head and elytra black, thorax yellow or yellow with piceous spots; maxillae as long as from the tip of the mandibles to the front of the eye, or slightly longer; hind tibiae with rather broad, equal, blunt spurs; antennae with first two segments about equal, third slightly longer. Length: 6–8 mm.

Zonitis piezata Fabricius

Zonitis piezata FABRICIUS, 1798, Supplementum entomologiae systematicae, p. 104.

Zonitis vittata FABRICIUS, 1801, Systema eleutheratorum, vol. 2, p. 24.

Nemognatha piezata, LeCONTE, 1853, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 347.

Nemognatha texana LeCONTE, 1853, *loc. cit.*

TYPE LOCALITY: "Carolina."

RECORDED DISTRIBUTION: *Mexico*. Vera Cruz: Jalapa, Atoyac.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: Delicias, 23.

This series represents the most northern record for the species in Mexico. There is a wide gap of territory between Vera Cruz and Chihuahua which should yield further specimens.

Fourteen of the above specimens are entirely tan above, seven

have a black stripe on each elytron, and two have the elytra black except for a narrow tan border. The two dark ones are also black below, but the lighter colored ones are either tan or black below.

DESCRIPTION: Head and thorax tan, elytra tan or tan with black stripes, or all black; maxillae as long as the body; hind tibiae with spurs about equal but the outer one truncate, the inner one pointed. Surface with short hairs. Length: 12–15 mm.

Zonitis lutea (LeConte)

Nemognatha lutea LeConte, 1853, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 346.

Nemognatha pallens LeConte, 1853, *loc. cit.*

TYPE LOCALITY: "Missouri Territory."

RECORDED DISTRIBUTION: *Mexico*. Northern Sonora.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: 92 kilometers north of Chihuahua, one; 239 kilometers south of Ciudad Juárez, five.

These specimens are yellow except for the dark antennae and maxillary lobe. The thorax is somewhat darker than the elytra, being more red yellow than yellow.

DESCRIPTION: Head and elytra yellow, thorax red yellow; maxillae as long as the body; hind tibiae with spurs about equal but the outer one truncate, broader, the inner one pointed, narrower. Surface with short hairs. Length: 9–14 mm.

Zonitis lurida (LeConte)

Nemognatha lurida LeConte, 1853, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 345.

Nemognatha decipiens LeConte, 1853, *ibid.*, vol. 6, p. 347.

Nemognatha rufa Dugès, 1889, Ann. Mus. Michoacano, vol. 2, p. 111.

TYPE LOCALITY: Platte River, "Missouri Territory," and Texas.

RECORDED DISTRIBUTION: *Mexico*. Northern Sonora. Coahuila: Monclova. Durango: Villa Lerdo.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: Delicias, five. Coahuila: San Pedro de Colonias, six. Guadalupe, one.

OTHER SPECIMENS EXAMINED: *Mexico*. Coahuila: Monclova (Dr. Palmer), one.

Four of the Chihuahua specimens are tan above, and one has the elytra dark brown. One of the tan ones has the scutellum black and is all black below except for the last two abdominal

segments (*decipiens* of LeConte); the others are yellow below except for the black tibiae and tarsi. The Coahuila specimens are all tan above and like the majority of Delicias specimens below.

The Monclova specimen is one of Godman's.

DESCRIPTION: Head and thorax tan, elytra tan to dark brown; maxillae as long as half the body; hind tibiae with spurs unequal, the outer one four or five times larger and concavely truncate, the inner one more or less stick-like. Surface with short hairs. Length: 10–15 mm.

Zonitis megalops Champion

Zonitis megalops CHAMPION, 1892, *Biologia Centrali-Americana*, vol. 4, pt. 2, pp. 386–387, pl. 17, fig. 26.

TYPE LOCALITY: Guatemala; Volcan de Atitlán (3000 feet).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: Delicias, three. Durango: Pedricena, three.

One of the Delicias specimens is only 9 mm.; the others are all about 20 mm. The Durango specimens are darker than those from Chihuahua, appearing nearly black to the naked eye. The thorax in all has a dark red suffusion in the center and on the sides; the impressed median line seems to be lacking in the small specimen from Delicias. Below, the three Chihuahua and one of the Durango specimens are yellow except for the black tips of the femora, the apical three-fourths of the tibiae and the tarsi; the other Durango specimens have the abdomen dark brown to black, and one of them has some dark brown on the metasternum.

This species, with its large eyes nearly touching beneath the head and only narrowly separated above, with its antennae nearly as long as the body and much thinner at the apex, does not resemble others of the genus *Zonitis*, although the tarsal claws and slightly prolonged maxillae place it in that genus. The above characters might well be sufficient for the erection of a new genus (see above under *Zonitis*). *Zonitis megalops* may, however, be a synonym of Horn's *longicornis* (1870, pp. 93–94), described from central Illinois, the description of which agrees with the lighter colored Mexican specimens. Three other similar specimens from the American Museum collection have been examined from Blythe, California, the Baboquivari Mountains, Arizona, and Biscayne Bay, Florida. If these all should prove to be the same

species, the geographical range is quite extensive, but since *Zonitis* are parasitic in the nests of bees their distribution can be expected to be both wide and erratic.

Also examined are four specimens, labeled *Zonitis annulicornis* (Chevrolat), from Puerto Rico, Haiti, and the Dominican Republic. These agree in the essential characters with the above, but differ in being all yellow except for darker suffusions at the base and near the apex of the elytra and in the antennal segments' being more clearly ringed with yellow. Chevrolat described his species as an *Epicauta* (1877), and it is interesting to note that Horn had seen his *longicornis* in collections also under *Epicauta*. Neither of these authors in his description mentioned the eyes, but the other characters and the specimens examined are sufficient for identification.

Two additional specimens (from the Fly River, Papua, New Guinea) appear to be a different species in that the eyes are even larger and more approximate above and below; they are entirely yellow and as large as the largest Mexican specimens.

DESCRIPTION: Head and thorax yellow, thorax with red suffusions, elytra yellowish or very dark brown, with the side and sutural margins and a sinuous line on each elytron of a lighter color; maxillae scarcely as long as the palpi; hind tibiae with spurs nearly equal, but outer one slightly shorter, broader, and with the tip less pointed; antennae longer than half the body and attenuate; eyes nearly contiguous beneath. Surface with short hairs. Length: 9 (one specimen only)—20 mm.

Zonitis, species unknown

Thirteen specimens from Samalayuca, Chihuahua. These are about the same size as *lutea* and similar in appearance to that species, but differ from it in having shorter maxillae, and in the fact that the outer tibial spur on the hind legs is not truncate, the thorax is not square but longer than wide, and the elytra have larger, sparser punctures.

DESCRIPTION: Yellow above and below except the tarsi which are black (one specimen has the abdomen and metasternum piceous), the thorax more red yellow than the elytra; maxillae very short, scarcely as long as the palpi; hind tibiae with spurs about equal in length, but the outer one twice as broad as the inner and less pointed at the tip, the inner one narrow, pointed, stick-like. Surface with short hairs. Length: 10–13 mm.

Zonitis, species unknown

Three specimens, two from Palos Colorados, one from Coyotes, both in Durango. Somewhat similar to *lurida* but more hairy, with the eyes broader, more prominent, and the hind tibial spurs both narrow and equal.

DESCRIPTION: Tan above and below except for the black tips of the femora, and the tibiae and tarsi; maxillae nearly as long as half the body; hind tibiae with spurs equal in length and thickness, thin, pointed, stick-like. Surface with short black hairs; eyes bulging on the sides; second antennal segment very short, shorter than first, third segment longer than the following. Length: 9-12 mm.

Zonitis immaculata (Say)

Nemognatha immaculata SAY, 1817, Jour. Acad. Nat. Sci. Philadelphia, vol. 1, p. 22.

TYPE LOCALITY: "Plains of the Missouri."

RECORDED DISTRIBUTION: *Mexico*. Chihuahua: Santa Clara. No specimens examined.

Zonitis, species unknown

Twenty-three specimens from Palos Colorados, one from Otinapa, one from Nombre de Dios, two from 6 miles northeast of El Salto, all in Durango, and one from Temax, northern Yucatán (Gaumer).

The above are all shining, hairless specimens, entirely tan or yellow above, black or yellow or a mixture of the two colors below. The maxillae are about as long as the head, the hind tibial spurs are rather slender, the inner one narrow, pointed, the outer somewhat broader. The Godman specimen from Yucatán is labeled "*Nemognatha tarasca* Dugès" and also "sp.? near *immaculata*." It seems the same as the others. Length: 9-12 mm.

Zonitis, species unknown

Two specimens from Balleza, Chihuahua, and five from Encino, Durango.

These seven specimens are rather similar to those discussed above in being shining and hairless, but the maxillae are even shorter and the hind tibial spurs seem somewhat broader. One of the Balleza specimens is yellow and one has the elytra black,

and both are yellow below except for the dark tibiae and tarsi. The Durango specimens are similar below to those from Balleza, and above, one has the elytra black, two have it yellow with black stripes, and two have it immaculate. These, as well as the specimens above, are probably close to *immaculata* (Say), but the thorax is not impunctate as in that species. Length: 10–12 mm.

GENUS GNATHIUM KIRBY

Gnathium KIRBY, 1818, Trans. Linnean Soc. London, vol. 12, p. 425.

This appears to be a very weak genus, and I believe it should be united with *Zonitis*. Casey (1891, p. 170) listed both *Nemognatha* and *Gnathium* as synonyms of *Zonitis*, though without giving reasons. The former was accepted, provisionally, by Denier (1935) in his revision of the Meloidae and has so been considered since. But *Gnathium* is still listed as a separate genus, in spite of the fact that a number of workers have shown its weakness, and even Kirby stated that it was more or less intermediate between *Nemognatha* and *Zonitis*. Horn, as early as 1870, (p. 94), said that the discovery of more species had eliminated most of the characters separating *Gnathium* from *Zonitis* except the slight thickening of the antennae towards the apex, which is a rather poor generic character. Other characters were found for use in the generic key to the north central Mexican species, and these were checked with specimens of some United States species, but it is doubtful if they would hold with all members of the variable genus *Zonitis*, as now constituted.

Three of the five species of this genus have been reported from north central Mexico.

KEY TO THE SPECIES OF *Gnathium* IN NORTH CENTRAL MEXICO

1. Elytra piceous, thorax yellow.....*francilloni*
Elytra yellow, thorax yellow.....2
2. Elytra sparsely hairy; maxillae longer than head but not half the length of the body; elytra and thorax shining.....*nitidum*
Elytra densely hairy; maxillae longer than half the body; elytra and thorax more opaque.....*minimum*

Gnathium francilloni Kirby

Gnathium francilloni KIRBY, 1818, Trans. Linnean Soc. London, vol. 12, p. 426, pl. 22, fig. 6.

Nemognatha flavicollis LeCONTE, 1858, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4, p. 23.

TYPE LOCALITY: Georgia.

RECORDED DISTRIBUTION: *Mexico*. Durango: Durango City.

No specimens examined.

Gnathium nitidum Horn

Gnathium nitidum HORN, 1870, Trans. Amer. Ent. Soc., vol. 3, p. 95.

TYPE LOCALITY: Owen's Valley, California.

RECORDED DISTRIBUTION: *Mexico*. Durango: Villa Lerdo.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Coahuila: Guadalupe, 58; La Gloria, south of Monclova, four.

Some of these specimens are more or less piceous below and even have piceous areas at random on the thorax and elytra. The disc of the elytra, seen from above, often appears to be without pubescence, but the short dark hairs can always be seen at the margins of the elytra.

Gnathium minimum (Say)

Nemognatha minima SAY, 1824, Jour. Acad. Nat. Sci. Philadelphia, vol. 3, p. 306.

Gnathium walckenaeri CASTELNAU, 1840, Histoire . . . insectes coléoptères, vol. 2, p. 281.

Nemognatha longicollis LECONTE, 1858, Proc. Acad. Nat. Sci. Philadelphia, vol. 10, p. 77.

TYPE LOCALITY: Arkansas "near the Rocky Mountains."

RECORDED DISTRIBUTION: *Mexico*. Northern Sonora. Vera Cruz.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Coahuila: San Pedro de Colonias, one.

The elytra in this specimen are not paler than the head and thorax, as described by Say, but of the same color. The suture, however, is slightly darker than the rest of the elytra, which Champion (1892, p. 381) said was true of the Sonoran specimens he had seen. San Pedro de Colonias is in southwestern Coahuila.

GENUS **EPICAUTA** DEJEAN

Epicauta DEJEAN, 1833, Catalogue des coléoptères, ed. 2, p. 224.

Causima DEJEAN, 1837, *op. cit.*, ed. 3, p. 248.

Henous HALDEMAN, 1852, in Stansbury, Exploration and survey of the valley of the Great Salt Lake, p. 377.

Isopentra MULSANT, 1858, Opuscules entomologiques, vol. 8, p. 106.

Macrobasis LECONTE, 1858, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4, p. 39.

Apterospasta LeCONTE, 1858, *loc. cit.*

Nomaspis LeCONTE, 1866, Smithsonian Misc. Coll., vol. 6, no. 167, p. 156.

Gnathospasta Horn, 1875, Trans. Amer. Ent. Soc., vol. 5, p. 154.

This is one of the largest genera in the Meloidae and is cosmopolitan except that it does not occur in Australia. Thirty-three of the 60 odd species reported from Mexico have been taken in north central Mexico.

KEY TO THE SPECIES OF *Epicauta* IN NORTH CENTRAL MEXICO

1. Elytra with only a small black spot on each elytron near apex; general pubescence gray..... *punctum*
Elytra not so marked..... 2
2. Elytra with base and apex only broadly black, also head and two spots on thorax; general pubescence gray..... *tripartita*
Elytra not so marked..... 3
3. Second antennal segment half as long as third or shorter..... 4
Second antennal segment two-thirds as long as third or longer..... 25
4. Elytra with pattern of denuded spots of varying extent..... 5
Elytra without denuded spots..... 8
5. Elytral spots distinct, not run together; if hairs worn off, thorax with dense, fine punctures..... 6
Elytral spots indistinct, run together; if hairs worn off, thorax smooth, with a few scattered deep punctures..... 7
6. Male with first segment of front tarsi with hairy pad reaching from base to apex; male with last segment of maxillary palpi much enlarged, round in outline..... *maculata*
Male with first segment of front tarsi with hairy pad at apical third or half only; male with last segment of maxillary palpi but slightly enlarged, elongate in outline..... *normalis*
7. Male with last segment of labial palpi much enlarged, round in outline; male with last segment of maxillary palpi only slightly enlarged..... *andersoni*
Male with last segment of neither palpi enlarged, both elongate in outline..... *pardalis*
- 8.(4). Pubescence black..... 9
Pubescence white, tan, or yellow..... 12
9. Elytra somewhat bulbous, broadly exposing the abdomen; wings absent ... *conferta*
Elytra normal, exposing apex of abdomen only, if at all; wings present... 10
10. Hind tibiae with inner spur one-third longer than outer..... *corvina*
Hind tibiae with inner spur about the same length as outer..... 11
11. Small, 6-12 mm.; elytra black; hind tibiae with outer spur somewhat broader than inner..... *pennsylvanica*
Large, 13-24 mm.; elytra dark rufous; hind tibiae with spurs equal in width..... *jimenezii*
- 12.(8). Suture with line of white or dense pubescence and/or a similar line on each elytron..... 13
Suture and elytra without lines of white or dense pubescence..... 14

13. Antennal segments 1 and 3 about equal in length; apex of elytra usually with fine fringe of dense or white hairs; male with first tarsal segment on front legs longer than second segment and antennal segments flat, broad *rufipedes*
 First antennal segment at least half longer than third; apex of elytra without fringe of dense or white hairs; male with first tarsal segment on front legs shorter than second segment and antennal segments cylindrical, slender *hirsutipubescent*
- 14.(12). At least 15 mm. long, usually 20 mm. or more *longicollis* (in part)
 Less than 15 mm. long 15
15. Thorax with a pair of denuded callosities 16
 Thorax without denuded callosities 17
16. Smaller, with tawny pubescence, hind tibial spurs shorter. *callosa* (in part)
 Larger, with gray pubescence, hind tibial spurs longer *candidata*
17. Elytra gray (ground color black, pubescence white) and thorax reddish *tenella* (in part)
 Elytra, head, and thorax same color 18
18. Thorax with disc transversely raised in middle in front, front angles prominent *singularis*
 Thorax with disc convex or flattened, not transversely raised, front angles rounded 19
19. Penultimate antennal segments as broad as long *fortis*
 Penultimate antennal segments longer than broad 20
20. Antennae long, well surpassing base of thorax 21
 Antennae short, just reaching to or slightly beyond base of thorax 22
21. Hind tibiae straight; antennal segments of same thickness, first segment as long as, or longer than, third *stigmata* (in part)
 Hind tibiae slightly curved or strongly bowed; antennae tapering towards apex, first segment much shorter than third *auricomans*
22. Labrum broadly, deeply, semicircularly emarginate *emarginata*
 Labrum slightly, if at all, emarginate 23
23. Hind tibiae with outer spur broad, broader than inner one; small, not over 8 mm. *ferruginea*
 Hind tibiae with outer spur slender, same size as inner one; larger 24
24. Thorax almost square, bulging, arched in profile; eyes large, reaching nearly two-thirds of the way to back of head, subovate, scarcely indented behind antennae; color usually gray or dull brown *sericans*
 Thorax longer than wide, flat or concave, nearly straight in profile; eyes smaller, reaching about halfway to back of head, narrower, more indented behind antennae; color usually tawny or golden yellow
 *callosa* (in part)
- 25.(3). Elytra with black or white stripes 26
 Elytra uniformly colored 28
26. Elytra with four dark lines on pale background *sublineata*
 Elytra with pale lines on dark background 27
27. Thorax nearly square, median suture denuded; female with first antennal segment reaching to hind margin of eye, male with it reaching beyond eye but not beyond head; abdominal segments with sparse white hairs *purpurea*

- Thorax much longer than broad, median line with long white pubescence; female with first antennal segment reaching beyond the eye, male with it reaching beyond the head; abdominal segments with bands of dense white hairs.....*atrivittata*
28. Pubescence above black except for narrow line of white hairs around thoracic margins, sometimes incompletely margined.....*segmenta*
 Pubescence above not black.....29
29. Elytra with ground color black.....30
 Elytra with ground color not black.....32
30. Legs with ground color black.....31
 Legs with ground color reddish.....*tenella* (in part)
31. Large, usually 20 mm. or more; male with first antennal segment longer than head, female with it surpassing the eye..*longicollis* (in part)
 Smaller, usually less than 15 mm., male and female with first antennal segment shorter than, or just reaching the back of, the eye..*stigmata* (in part)
32. General color dark brown to black; margins of elytra and thorax fringed with pale pubescence.....*beckeri*
 General color tan or yellowish; no pale pubescence on margins of elytra or thorax.....33
33. Head, thorax, and abdomen with ground color black.....34
 Head, thorax, and abdomen with ground color tan or red, except for black band at apex of each abdominal segment.....*lauta*
34. Male with first antennal segment longer than head and not excavated at apex.....*polingi*
 Male with first antennal segment shorter than head and excavated at apex on outer side (rare).....*linearis*

Epicauta rufipedes (Dugès)

Figure 2

Cantharis rufipedes DUGÈS, 1870, La Naturelle, vol. 1, p. 163, pl. 2, fig. 4.

Cantharis cinctella DUGÈS, 1877, *ibid.*, vol. 4, p. 59, pl. 2, fig. 3.

Lytta subvittata HAAG, 1880, Deutsche Ent. Zeitschr., vol. 24, p. 47.

Epicauta vittula, BEAUREGARD, 1889, Ann. Soc. Ent. France, Bull. Séances, p. ccxii. New name for *L. subvittata* Haag.

TYPE LOCALITY: Michoacán.

RECORDED DISTRIBUTION: *Mexico*. Durango: Ventanas (A). Michoacán: Huétamo (B). Jalisco: Sayula (C). Puebla: Atlixco (D), Matamoros Izúcar (E). Colima: Tonila (F). Guerrero: Iguala (G), Chilpancingo (H), Dos Arroyos (I), Mochitlán (J), Acapulco (K), Rincón (L), Amula (M). Morelos: Cuernavaca (N). Vera Cruz: Jalapa (O), San Andres Tuxtla (P). Oaxaca: Tehuantepec (Q), Oaxaca (R). Yucatán: Temax (S). Chiapas: Tapachula (T). *Guatemala*. San Jerónimo. *Nicaragua*. Chontales.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Guer-

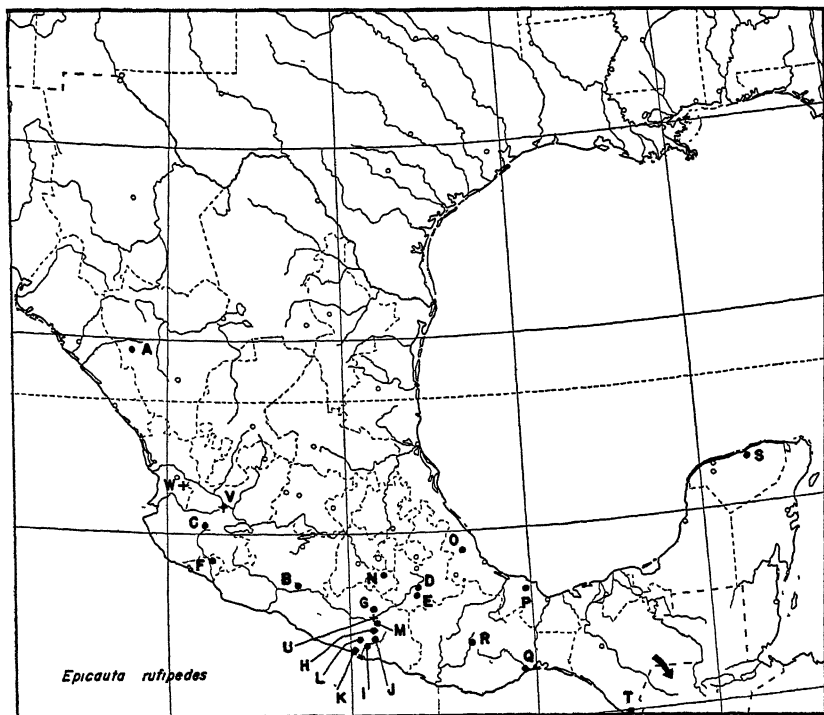


FIG. 2. Distribution of *Epicauta rufipedes* (Dugès).

rero: Xalitla (U), June 4, 1946 (J. and D. Pallister), three; Jalisco: Guadalajara (V), September, 1903 (W. L. Tower), four. Nayarit: Ixtlan del Rio (W), 3800 feet, June 14, 1949 (Bradt), one.

OTHER SPECIMENS EXAMINED: *Mexico*. Guerrero: Mochitlán (J) (Baron), one; Chilpancingo (H), October (H. H. Smith), 4600 feet, one; Iguala (G), June 2, 1946 (J. and D. Pallister), two. Jalisco: Sayula (C) (Höge), one. Morelos: Cuernavaca (N), July-August, 1903 (W. L. Tower), one. Vera Cruz: Jalapa (O) (W. Schaus), two. Oaxaca: Oaxaca (R) (Höge), one. Yucatán: Temax (S) (Gaumer), one. *Guatemala*. Baja Vera Paz: San Jerónimo (Champion), one. The following specimens taken July-August, 1947 (C. and P. Vaurie): Baja Vera Paz: San Jerónimo, 3000 feet, one; Salamá, 3000 feet, 15; Rabinal, 3000 feet, one. Zacapa: Zacapa, 600 feet, three. Quiché: Sacapulas, 4500 feet, two.

The median line of white or dense pubescence on each elytron is present in only two of the Guatemala specimens, also in the seven from Guerrero, four from Guadalajara in Jalisco, one from Oaxaca. The white line on the suture and at the apex is present in all except a few worn examples. The last segment of the maxillary palpi in the male is more dilated than in the female. The legs in all are red.

Six of these are Godman specimens seen by Champion (Mochitlán, Chilpancingo, Sayula, Temax, Oaxaca, and San Jerónimo in Guatemala).

***Epicauta punctum* (Dugès)**

Cantharis punctum DUGÈS, 1870, La Naturaleza, vol. 1, pp. 158-159, pl. 2, fig. 9.

TYPE LOCALITY: Mexico.

RECORDED DISTRIBUTION: *Mexico*. Durango: Ventanas. Jalisco: Guadalajara. Puebla: Matamoros Izúcar. Guerrero: Mochitlán. Vera Cruz. Parada [not located].

No specimens examined.

***Epicauta maculata* (Say)**

Figure 3

Lytta maculata SAY, 1824, Jour. Acad. Nat. Sci. Philadelphia, vol. 3, p. 298.

Lytta conspersa LECONTE, 1853, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 340.

Cantharis punctuata DUGÈS, 1870, La Naturaleza, vol. 1, p. 161, pl. 2, fig. 1.

Epicauta media DUGÈS, 1889, Ann. Mus. Michoacano, vol. 2, p. 82.

TYPE LOCALITY: "Missouri Territory."

RECORDED DISTRIBUTION: *Mexico*. Durango: Villa Lerdo (A). San Luis Potosí: Huasteca Potosina [not located]. Guanajuato: Irapuato (B). Michoacán: Morelia (C), Quiroga (D). Morelos: Yautepec (E). Distrito Federal: Mexico City (F). Querétaro: Querétaro (G). Hidalgo: Tula (H). Oaxaca: Oaxaca (I). *Guatemala*. Quiché Mountains.

No specimens examined.

The above recorded distribution of *maculata* probably includes more than one species, since recently found characters used by Werner to separate the *maculata-normalis* group in the United States were not mentioned by former authors. Werner, in fact, believes that the two Dugès species synonymized by Champion may be distinct species. It is possible also that some of the speci-

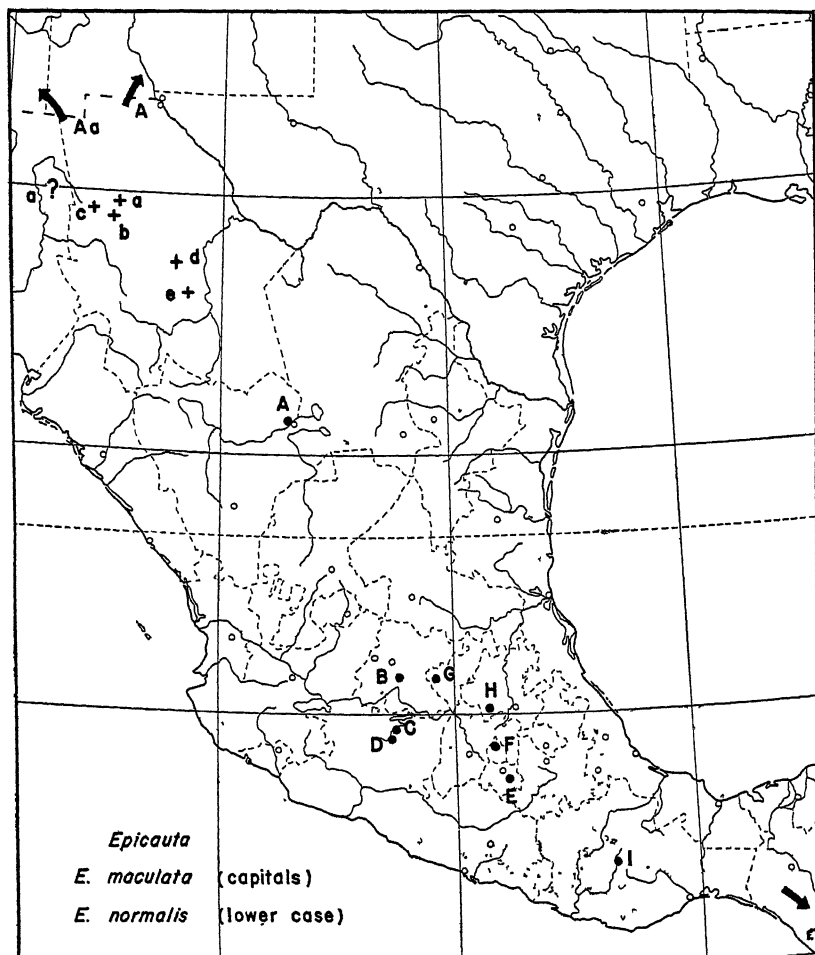


FIG. 3. Distribution of *Epicauta normalis* Werner and *E. maculata* (Say).

mens discussed below in the text of *normalis* could be referable to *maculata*.

***Epicauta normalis* Werner**

Figure 3

Epicauta normalis WERNER, 1943, Psyche, vol. 50, pp. 65-66.

TYPE LOCALITY: Bridgeport, California.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chi-

huahua: San José Babicora (a), 353; Matachic (b), four; Madera (c), two; 16 miles southeast of Chihuahua (d), one; Delicias (e), three. Sonora: (C. Lumholtz), one.

This large series was at first thought to be *maculata*, but the apical segments of the male palpi are not enlarged or rounded, and the male front tarsi (first segment) have the pad at the apical third only. This represents the first record of *normalis* in Mexico. Unfortunately there is no adequate material from Sonora, which intervenes between Chihuahua and the Arizona and California localities where *normalis* has been taken. (For an account of the similar species of this group, see Werner, 1949b, pp. 95-99.)

Not included in this species are one specimen from La Rosa, Coahuila, three from Guadalupe, Coahuila, 40 from Guadalajara, Jalisco, 1901 (M. Digue), and 119 from Guadalupe, Distrito Federal, July 27, 1903 (W. L. Tower). These specimens not only present some slight differences from *normalis* in the shape and expansion of the male palpi and in the pad on the front first tarsal segment in the male, but they also are more southern in distribution. There are two Dugès species, synonymized by Champion with *maculata*, which Werner believes may be good species and to which all or some of these specimens may eventually be referred. The Dugès species were described from the states of Guanajuato, Michoacán, and San Luis Potosí.

Although there are many small specimens in the Chihuahua *normalis*, there are no large ones in the Distrito Federal specimens which, as a whole, are smaller and darker (the latter may be due to the age of the specimens).

It is a very difficult species (or perhaps subspecies) group and probably cannot be resolved, as Werner said, until more material with host plant records is available.

Epicauta pardalis LeConte

Figure 4

Epicauta pardalis LeConte, 1866, Smithsonian Misc. Coll., vol. 6, no. 167, p. 157.

TYPE LOCALITY: Valley of the Gila.

RECORDED DISTRIBUTION: *Mexico*. Northern Sonora. Coahuila: Saltillo (A) (Werner, 1945, p. 443). Durango: Descubridora (B) (Werner, *loc. cit.*).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: 80 and 92 kilometers north of Chihuahua (C), 21; Ojo

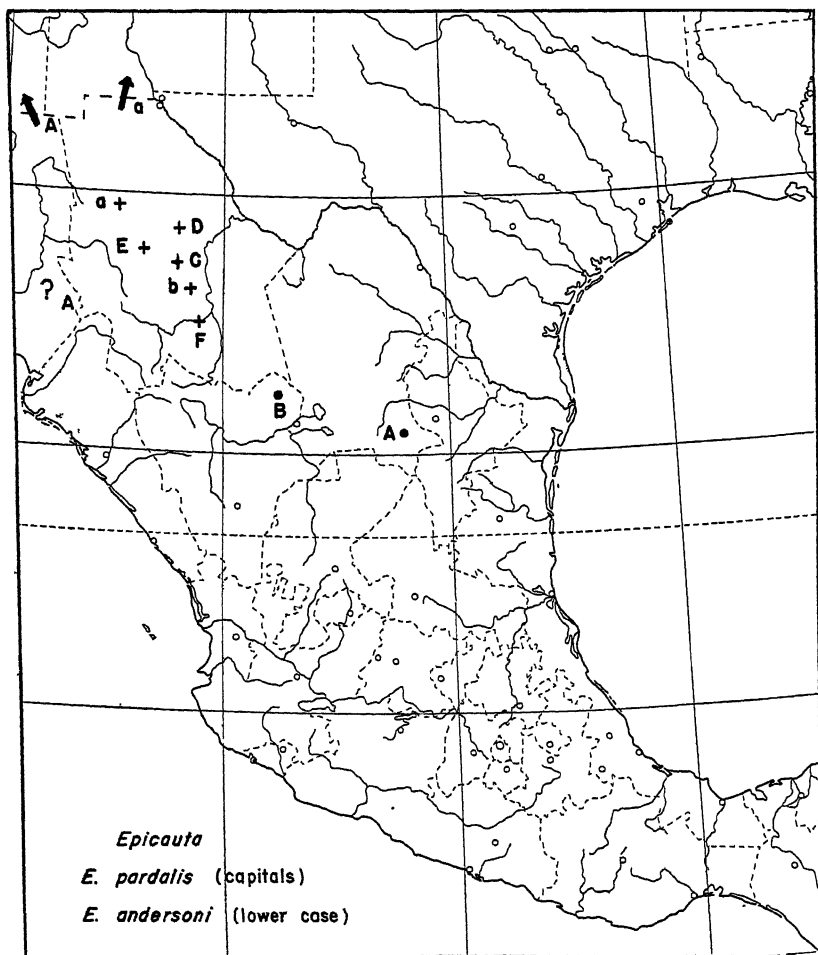


FIG. 4. Distribution of *Epicauta pardalis* LeConte and *E. andersoni* Werner.

Laguna (D), nine; Primavera (E), three; 20 and 25 miles southwest of Camargo (F), three; 42 miles southwest of Camargo, one.

OTHER SPECIMENS EXAMINED: *Mexico*. Sonora (C. Lumholtz), 25.

The specimens from Camargo are females and they might possibly be *andersoni*, but the antennae seem a little thicker than in that species and three of them are larger than most *andersoni*.

The Sonora specimens do not seem to differ from those of Chihuahua.

***Epicauta andersoni* Werner**

Figure 4

Epicauta andersoni WERNER, 1943, Psyche, vol. 50, pp. 66-67.

TYPE LOCALITY: Gallo Springs, New Mexico.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: San José Babícora (a), 17; Delicias (b), one.

Since this species has been so recently described, it is not surprising that no specimens have been reported from Mexico. Some of the specimens of *pardalis* recorded by Champion, however, might have been *andersoni*.

Only three or four of the series are well marked, the rest having most of the pubescence worn off the upper surface. The abraded males can be distinguished from equally abraded males of the *maculata-normalis* group by the labial palpi; abraded females can be distinguished by the thorax, which in *andersoni* is smooth between the scattered deep punctures, whereas in *maculata* and *normalis* the entire surface is set with dense fine punctures with here and there a larger puncture. When the pubescence is present the sculpture cannot be seen.

The only way to separate females of *andersoni* and *pardalis* is by associating them with males from the same locality, though in general *andersoni* is a smaller species, and the antennae, if both species are present for comparison, are somewhat more slender.

Epicauta jimenezi* DugèsEpicauta jimenezi* DUGÈS, 1889, Ann. Mus. Michoacano, vol. 2, p. 73.

TYPE LOCALITY: Guadalajara.

RECORDED DISTRIBUTION: *Mexico*. Durango: Ventanas, Canelas. Jalisco: Guadalajara.

No specimens examined.

***Epicauta corvina* (LeConte)**

Figure 5

Lytta corvina LECONTE, 1858, Jour. Nat. Sci. Philadelphia, ser. 2, vol. 4, p. 21
Cantharis nigerrima DUGÈS, 1870, La Naturelle, vol. 1, p. 162.

TYPE LOCALITY: Valley of the Gila.

RECORDED DISTRIBUTION: *Mexico*. Chihuahua: Santa Clara (A). Durango: Villa Lerdo (B), Canelas (C). Guanajuato:

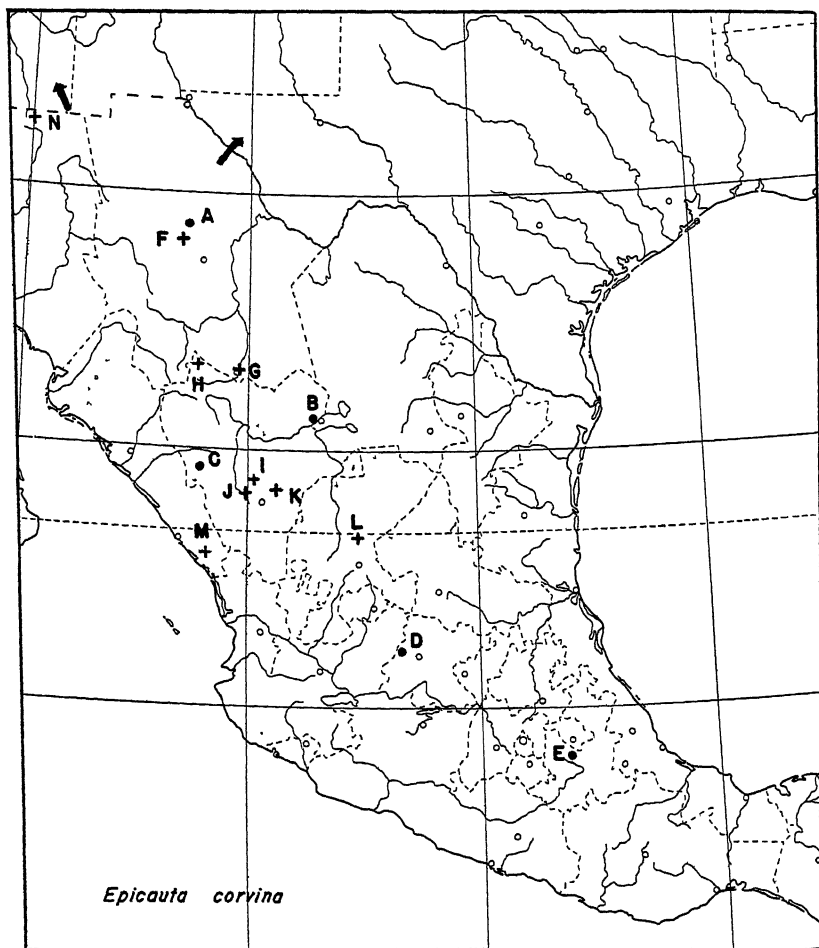


FIG. 5. Distribution of *Epicauta corvina* (LeConte).

León (D), Mineral del Cedro [not located]. Puebla: Puebla (E). Vera Cruz.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: Santa Clara Canyon, 5 miles west of Parrita (F), one; Catarinas (G), eight. Durango: Las Puente (H), eight; San Juan del Rio (I), five; Palos Colorados (J), one; Providencia (K), three. Zacatecas: Fresnillo (L), one. Sinaloa: Escuinapa (M) (J. H. Batty), 129. Sonora: Naco (N), 5000 feet, August 16, 1949 (Bradt), 50.

There is considerable variation in the thorax in *corvina*; by actual measurement it is usually only slightly wider than long (it may appear longer than wide to the eye), but a few individuals have it very much wider than long. The more or less round median depression at the base of the thorax is much more marked in some specimens, but occasionally it is scarcely evident.

***Epicauta pennsylvanica* (DeGeer)**

Cantharis pennsylvanica DEGEER, 1775, Mémoires . . . l'histoire des insectes, vol. 5, p. 16, pl. 13, fig. 1.

Meloe nigra WOODHOUSE, 1800, Med. Repos., vol. 3, p. 213.

Lytta pennsylvanica, LECONTE, 1853, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 329.

Lytta morio LECONTE, 1853, *ibid.*, vol. 6, p. 447.

Epicauta potosina DUGÈS, 1889, Ann. Mus. Michoacano, vol. 2, p. 89.

TYPE LOCALITY: Pennsylvania.

RECORDED DISTRIBUTION: *Mexico*. Coahuila: Monclova. Durango: Villa Lerdo. San Luis Potosí: Huasteca [not located].

No specimens examined.

***Epicauta conferta* (Say)**

Meloe conferta SAY, 1824, Jour. Acad. Nat. Sci. Philadelphia, vol. 3, pp. 281-282.

Henous techanus HALDEMAN, 1852, in Stansbury, Exploration and survey of the valley of the Great Salt Lake, p. 377, pl. 9, figs. 12-14.

Henous confertus, LECONTE, 1853, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 330.

TYPE LOCALITY: "In vicinity of Council Bluffs and near the Rocky Mountains." Neotype locality: Dallas, Texas, designated by Werner (1945, p. 449).

RECORDED DISTRIBUTION: *Mexico*. Coahuila: San Pedro.

No specimens examined.

***Epicauta tripartita* Champion**

Epicauta tripartita CHAMPION, 1892, Biologia Centrali-Americana, vol. 4, pt. 2, p. 421, pl. 19, fig. 20.

TYPE LOCALITY: Ventanas in Durango.

Type examined in British Museum.

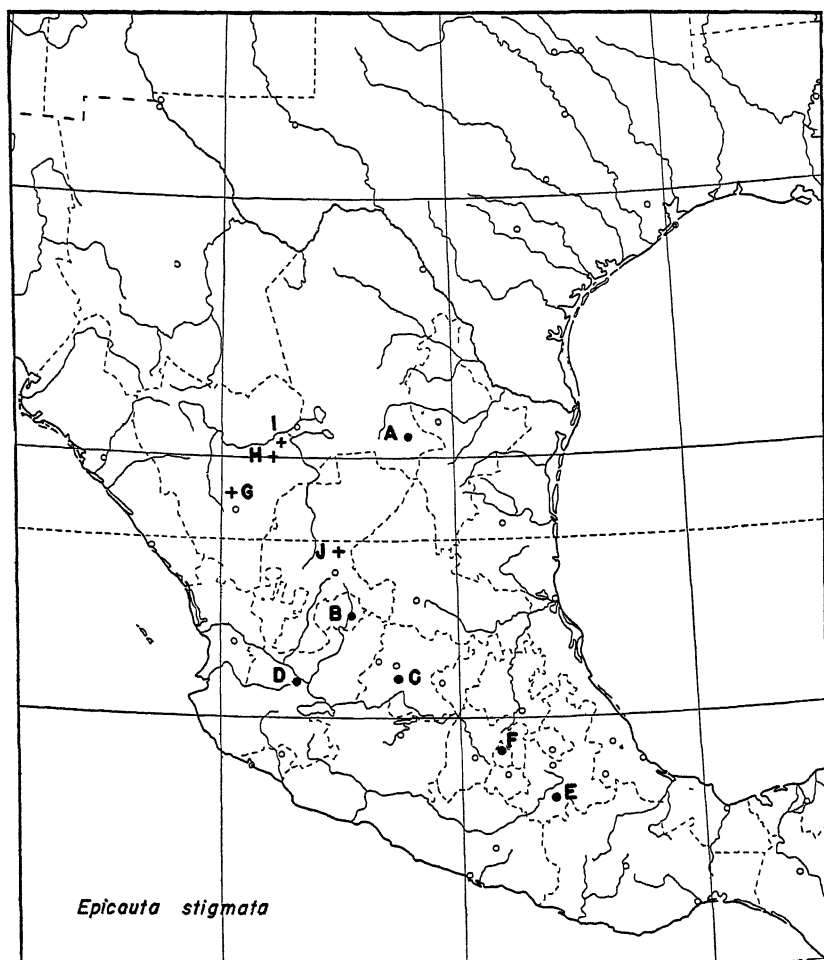


FIG. 6. Distribution of *Epicauta stigmata* (Dugès).

Epicauta stigmata (Dugès)

Figure 6

Cantharis stigmata DUGÈS, 1870, La Natureza, vol. 1, p. 159, pl. 2, fig. 8.

Epicauta nigratarsis DUGÈS, 1877, *ibid.*, vol. 3, p. 48.

Epicauta intermedia DUGÈS, 1889, Ann. Mus. Michoacano, vol. 2, p. 68.

TYPE LOCALITY: Guanajuato.

RECORDED DISTRIBUTION: *Mexico*. Coahuila: Saltillo (A).
Aguascalientes: Aguascalientes City (B). Querétaro. Guana-

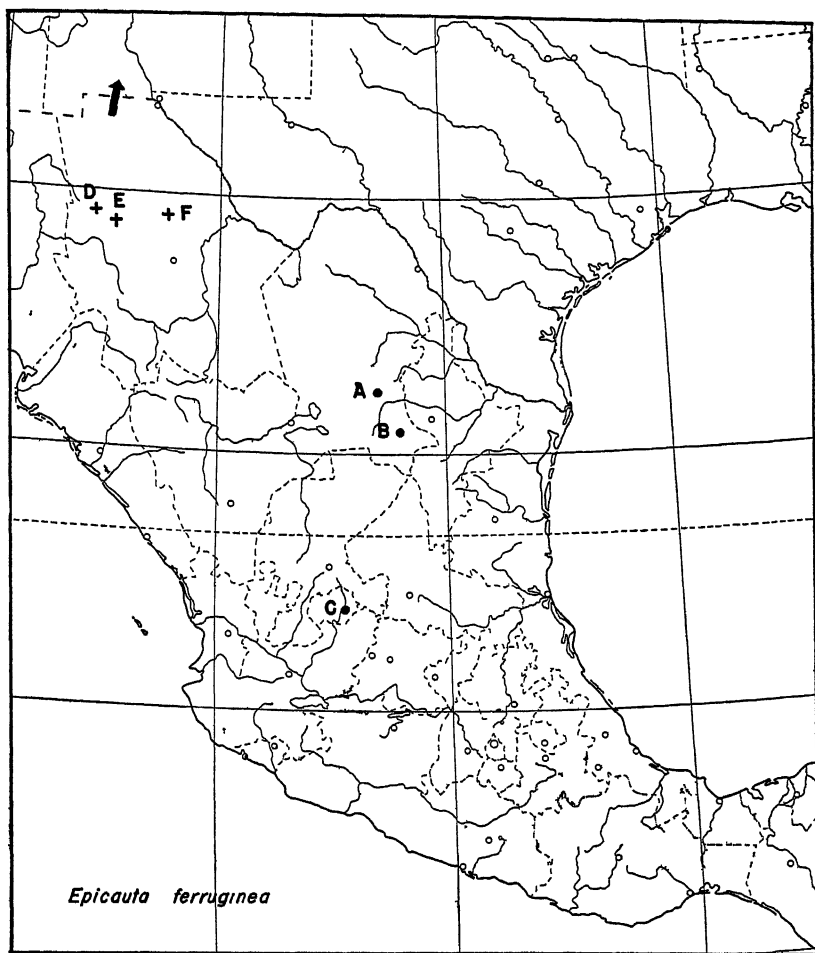


FIG. 7. Distribution of *Epicauta ferruginea* (Say).

juato: Irapuato (C). Jalisco: Guadalajara (D). Michoacán. Puebla: Matamoros Izúcar (E). Distrito Federal: Volcan Ixtaccihuatl (F). Vera Cruz.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Durango: San Lucas (G), two; Cuencamé District, Verbanís (H), one; Pedricena (I), one. Zacatecas: Fresnillo (J), 24.

OTHER SPECIMENS EXAMINED: *Mexico*. Distrito Federal: Guadalupe (F), August 31, September 7, 1903 (W. L. Tower), 21.

All these specimens have the ground color black and the pubes-

cence either grayish white or tan; in one or two it is more tawny. The Guadalupe series seems grayer, but these are older specimens and may be dulled.

***Epicauta auricomans* Champion**

Epicauta auricomans CHAMPION, 1892, *Biologia Centrali-Americana*, vol. 4, pt. 2, pp. 424-425, pl. 19, figs. 22, 22a.

TYPE LOCALITY: Not given; here designated as Oaxaca, from original label on type.

RECORDED DISTRIBUTION: *Mexico*. Coahuila: Saltillo. Oaxaca: Almolonga.

Type examined in British Museum.

***Epicauta ferruginea* (Say)**

Figure 7

Lytta ferruginea SAY, 1824, *Jour. Acad. Nat. Sci. Philadelphia*, vol. 3, p. 298.

? *Lytta sartorii* HAAG, 1880, *Deutsche Ent. Zeitschr.*, vol. 24, p. 56.

TYPE LOCALITY: "On the Missouri." Neotype locality, designated by Werner (1945, p. 466): Cambridge, Nebraska.

RECORDED DISTRIBUTION: *Mexico*. Coahuila: Monclova (A), Saltillo (B). Guerrero: Alvarez Mountains. Aguascalientes: Aguascalientes City (C). Mirador [not located].

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: Madera (D), five; 2 miles west of Matachic (E), one; Santa Clara (F), two.

One of the Madera specimens and the two from Santa Clara have the pubescence yellower, not so gray as in the others. These specimens are not so tawny as the majority of a series seen from Colorado.

***Epicauta fortis* Werner**

Epicauta fortis WERNER, 1943, *Psyche*, vol. 50, p. 69.

TYPE LOCALITY: Phoenix, Arizona.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Coahuila: Guadalupe, two; La Gloria, south of Monclova, one.

This is the first record in Mexico of this small gray species. It somewhat resembles *ferruginea* but is broader and has the penultimate antennal segments as broad as long.

***Epicauta candida* Champion**

Epicauta candida CHAMPION, 1892, Biologia Centrali-Americana, vol. 4, pt. 2, p. 426.

TYPE LOCALITY: Villa Lerdo in Durango.

Type examined in British Museum.

***Epicauta callosa* LeConte**

Epicauta callosa LECONTE, 1866, Smithsonian Misc. Coll., vol. 6, no. 167, p. 158.

TYPE LOCALITY: Nebraska.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: La Cruz, one; Delicias, six; 10 miles south of Delicias, 17.

Although this species has not been reported before from Mexico, it has been taken about 200 miles to the northeast of Delicias, at Alpine, Texas (Werner, 1945, p. 469), and also south of Hereford, Arizona, a few miles from the border. Two of the specimens have grayish yellow pubescence, but the others are of a brighter, more tawny color.

***Epicauta sericans* LeConte**

Figure 8

Epicauta sericans LECONTE, 1866, Smithsonian Misc. Coll., vol. 6, no. 167, p. 158.

TYPE LOCALITY: Kansas.

RECORDED DISTRIBUTION: "Along the Gulf as far as Vera Cruz" (Werner, in letter).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: Madera (A), one. Coahuila: 192 kilometers south of Piedras Negras (B), six. Durango: Palos Colorados (C), 10; 6 miles northeast of El Salto (D), one. San Luis Potosí: Valles (E), July 21, 1946 (J. and D. Pallister), 11. Distrito Federal: Guadalupe (F), August 31, 1903 (W. L. Tower), one.

With the exception of one of the Piedras Negras specimens, the northern specimens appear browner than, not so gray as, the series from Valles. Under a lighted microscope their pubescence is seen to be yellow, whereas the Valles specimens and the one from Guadalupe have white pubescence. Werner thinks the northern ones may be a distinct subspecies.

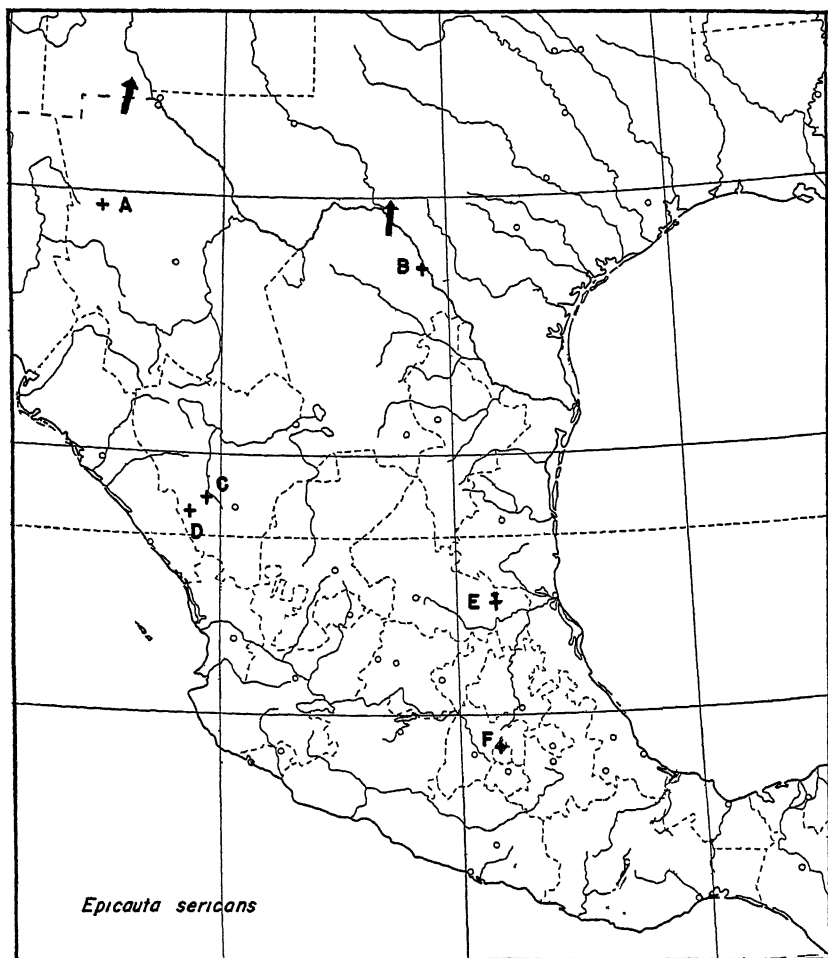


FIG. 8. Distribution of *Epicauta sericans* LeConte.

***Epicauta emarginata* Champion**

Epicauta emarginata CHAMPION, 1892, Biologia Centrali-Americana, vol. 4, pt. 2, pp. 426-427, pl. 19, fig. 24.

TYPE LOCALITY: San Isidro in Coahuila.

Type examined in British Museum.

***Epicauta singularis* Champion**

Epicauta singularis CHAMPION, 1892, Biologia Centrali-Americana, vol. 4, pt. 2, p. 427, pl. 19, fig. 25.

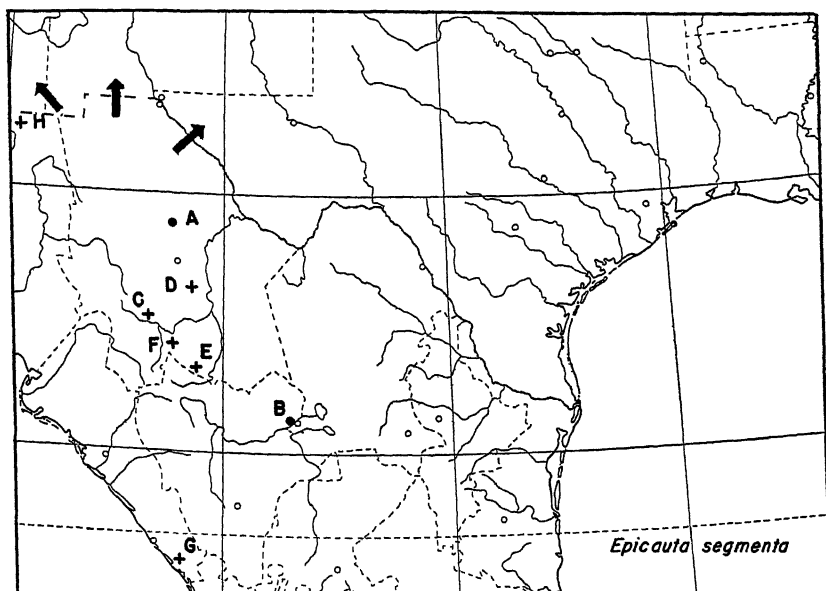


FIG. 9. Distribution of *Epicauta segmenta* (Say).

TYPE LOCALITY: Not given; here designated as Nuevo León, Monterrey, from original label on type.

RECORDED DISTRIBUTION: *Mexico*. Coahuila: Saltillo. Nuevo León: Monterrey.

Type examined in British Museum.

Epicauta segmenta (Say)

Figure 9

Lytta segmenta SAY, 1824, Jour. Acad. Nat. Sci. Philadelphia, vol. 3, p. 303.

Lytta segmentata LECONTE, 1853, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 342.

Apterospasta valida LECONTE, 1858, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4, p. 39.

Macrobasis segmentata, HORN, 1873, Proc. Amer. Phil. Soc., vol. 13, p. 93.

Macrobasis cinctothorax DUGÈS, 1889, Ann. Mus. Michoacano, vol. 2, p. 56.

TYPE LOCALITY: "Purgatory River of the Arkansa." Neotype locality designated by Werner (1945, p. 491): Fort Hayes, Kansas.

RECORDED DISTRIBUTION: *Mexico*. Chihuahua: Santa Clara (A). Durango: Villa Lerdo (B).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: Valle de Olivos (C), one; Delicias (D), three; 10 miles south of Delicias, one; Catarinas (E), six, June 18, 1947 (Bradt), one; Parral (F), one. Sinaloa: Escuinapa (G) (J. H. Batty), nine. Sonora: (C. Lumholtz), one; Naco (H), 5000 feet, August 15, 1949 (Bradt), one.

In one of the Catarinas specimens the second and third antennal segments on the right side are of the same length, while on the left side the third segment is longer, as is normal.

These are the fully winged form of this dimorphic species. Champion's six specimens were also fully winged (1892, p. 401).

***Epicauta sublineata* (LeConte)**

Lytta sublineata LECONTE, 1853, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 447.

Macrobasis sublineata, HORN, 1873, Proc. Amer. Phil. Soc., vol. 13, p. 94.

Macrobasis megacephala CHAMPION, 1892, Biologia Centrali-Americana, vol. 4, pt. 2, p. 402, pl. 18, figs. 24, 24a.

TYPE LOCALITY: Eagle Pass, Texas.

RECORDED DISTRIBUTION: *Mexico*. Coahuila: Monclova.

No specimens examined.

Champion's two specimens of *megacephala* had the elytra black with the tip white and no lines.

***Epicauta lauta* (Horn)**

Macrobasis lauta HORN, 1885, Trans. Amer. Ent. Soc., vol. 12, pp. 108-109.

Epicauta compressicollis CHAMPION, 1892, Biologia Centrali-Americana, vol. 4, pt. 2, pp. 427-428, pl. 19, fig. 26.

TYPE LOCALITY: Arizona.

RECORDED DISTRIBUTION: *Mexico*. Durango: Villa Lerdo.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: 10 miles south of Delicias and Delicias, two; 25 and 42 miles southwest of Camargo, four. Coahuila: San Pedro de Colonias, one. Durango: Pedricena, two.

This species had not been reported from Mexico before as *lauta*, but Werner (in letter) stated that Champion's *compressicollis* from Villa Lerdo was an "undoubted synonym."

The above nine specimens do not vary noticeably in color or pubescence. The apex of the femora and the entire tibiae and tarsi of the middle and hind legs are black, contrasting with the general reddish coloration. The ground color of the body below

is reddish, not black as in *polingi* and *diversicornis*, with black bands at the apex of each abdominal segment.

The Durango and Coahuila localities are quite close to each other; those of Chihuahua are nearly a third of the way north to Arizona.

***Epicauta tenella* (LeConte)**

Lytta tenella LeConte, 1858, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4, p. 23.

Macrobasis tenella, Horn, 1873, Proc. Amer. Phil. Soc., vol. 13, p. 94.

TYPE LOCALITY: Llano Estacado (western Texas or eastern New Mexico).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: Delicias, 65; 10 miles south of Delicias, two.

This is the first recorded occurrence of *tenella* in Mexico. The series is rather uniform. Some specimens have a darker suffusion on the reddish tan ground color of the thorax, but the contrast of the red head and thorax with the gray elytra is almost always readily visible.

***Epicauta purpurea* (Horn)**

Macrobasis purpurea Horn, 1885, Trans. Amer. Ent. Soc., vol. 12, pp. 108, 110.

TYPE LOCALITY: Arizona.

RECORDED DISTRIBUTION: *Mexico*. Durango: Ventanas.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Durango: Palos Colorados, one.

This specimen, a male, agrees with Champion's redescription (1892, pp. 397-398) of *purpurea*, which he gave because of some slight discrepancies with Horn's Arizona specimen.

Ventanas is near the western border of central Durango; Palos Colorados is somewhat southward, not far from Durango City.

***Epicauta polingi* Werner**

Figure 10

Epicauta polingi Werner, 1943, Psyche, vol. 50, pp. 71-72.

Macrobasis diversicornis, Champion, 1892, Biologia Centrali-Americana, vol. 4, pt. 2, p. 399 (in part).

TYPE LOCALITY: Davis Mountains, Texas.

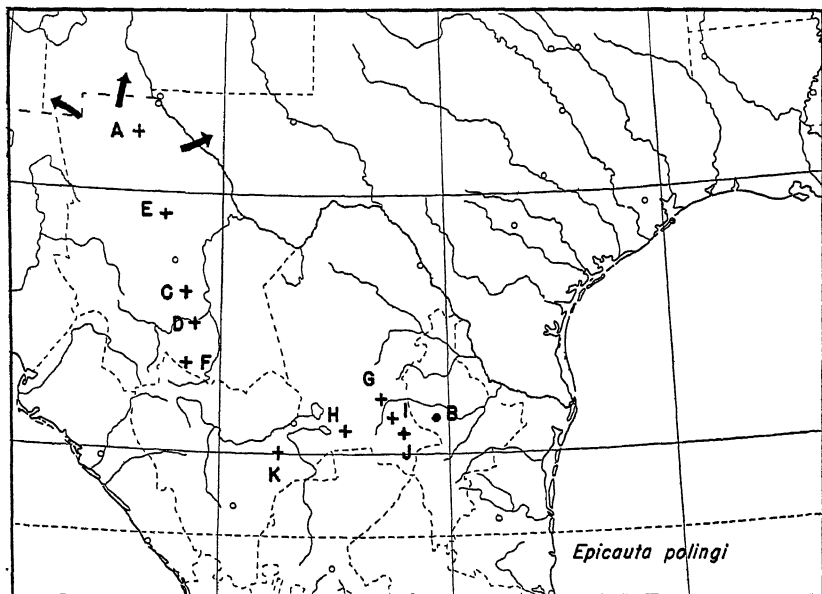


FIG. 10. Distribution of *Epicauta polingi* Werner.

RECORDED DISTRIBUTION: *Mexico*. Nuevo León: Monterrey (B).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: Samalayuca (A), one; Delicias (C), 52; 10 miles south of Delicias, 11; 20 miles southwest of Camargo (D), one; Ojo Laguna (E), one; Catarinas (F), one. Coahuila: La Gloria, south of Monclova (G), one; Paila (H), one; Guadalupe (I), one; 5 miles north of Saltillo (J), one. Durango: Pedricena (K), two.

From the same locality (Delicias) there are about a dozen specimens measuring only 10 to 13 mm., while the largest reach 18 to 20 mm. The ground color of the head and thorax is black in all, but the pubescence is occasionally yellow instead of the usual gray white. The black ground color serves to distinguish the females from the females of *diversicornis* (Sinaloa and southern Mexico) and *arizonica* (Sonora), in both of which the ground color is reddish.

Some or all of Champion's northern records of *diversicornis* (Haag) undoubtedly refer to *polingi*, as Werner has made a study of the former (Psyche, 1949a, pp. 74-80) and he finds it to be a

more southern species. Champion's records were Chihuahua City, Chihuahua, and Villa Lerdo and Ventanas in Durango.

***Epicauta beckeri* (Dugès)**

Macrobasis bekeri [sic] DUGÈS, 1889, Ann. Mus. Michoacano, vol. 2, pp. 113-114.

TYPE LOCALITY: Canelas in Durango.

RECORDED DISTRIBUTION: *Mexico*. Durango: Canelas. Nayarit: Tepic. Jalisco: Colima Vulcano (Werner, 1949a, p. 76).

No specimens examined.

***Epicauta longicollis* (LeConte)**

Lytta longicollis LECONTE, 1853, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 343.

Macrobasis longicollis, HORN, 1873, Proc. Amer. Phil. Soc., vol. 13, p. 90.

TYPE LOCALITY: Santa Fe, New Mexico.

RECORDED DISTRIBUTION: *Mexico*. Northern Sonora.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: Ojo Laguna, five; 182 kilometers north of Chihuahua, 30; 10 miles south of Delicias, one.

Champion had seen only three specimens of this species. It is quite similar to *albida* from Texas, but lacks the dark lines on the thorax and the light-colored antennae. Some of the above specimens have most of the gray yellow pubescence worn off, resulting in a mottled appearance.

The new localities are in central eastern Chihuahua.

***Epicauta atrivittata* (LeConte)**

Lytta atrivittata LECONTE, 1854 (1856), Proc. Acad. Nat. Sci. Philadelphia, vol. 7, p. 224.

Macrobasis atrivittata, HORN, 1873, Proc. Amer. Phil. Soc., vol. 13, pp. 90-91.

TYPE LOCALITY: "San Diego trip."

RECORDED DISTRIBUTION: *Mexico*. Tamaulipas: Tlahualilo (Werner, 1945, p. 510).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: 20 miles southwest of Camargo, one; 10 miles south of Delicias, 21.

This handsome and unmistakable species must be, as Werner (1945, p. 510) says, "quite scarce," since so few records of it have been reported and Champion did not have it for the "Biologia."

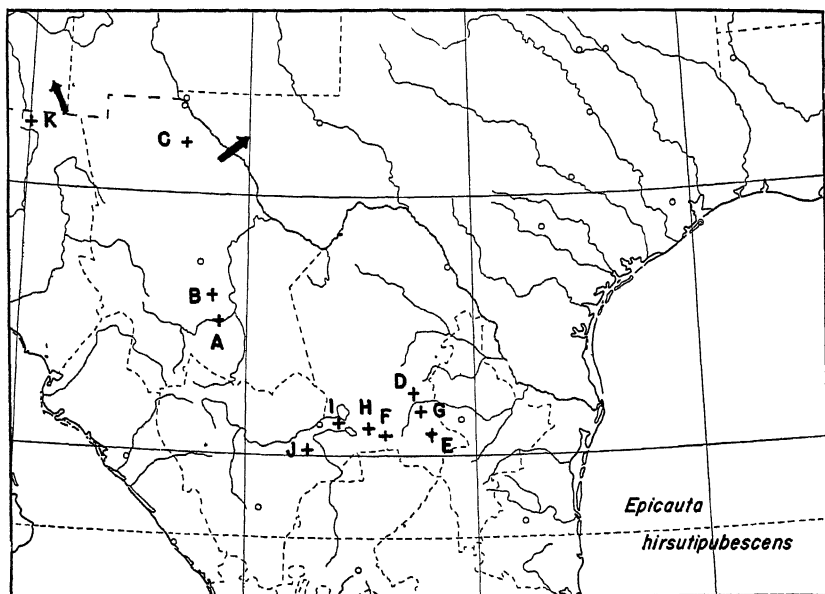


FIG. 11. Distribution of *Epicauta hirsutipubescens* (Maydell).

The state of Tamaulipas is separated from Chihuahua by both Coahuila and Nuevo León, and *atrivittata* no doubt occurs between. Tlahualilo is in the extreme southwestern part of Tamaulipas.

The above series is quite uniform in its elytral markings, but the amount of black on the thorax varies somewhat.

Epicauta hirsutipubescens (Maydell)

Figure 11

Macrobasis hirsutipubescens MAYDELL, 1934, Trans. Amer. Ent. Soc., vol. 60, p. 334.

Epicauta virgulata, WERNER, 1945, Bull. Mus. Comp. Zool., vol. 95, p. 512 (in part).

TYPE LOCALITY: Texas.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: 20 and 25 miles southwest of Camargo (A), 20; 42 miles southwest of Camargo, two; Delicias (B), two; Samalayuca (C), one. Coahuila: La Gloria, south of Monclova (D), one; 5 miles north of Saltillo (E), 27; Cabos (F), two; Guadalupe (G),

eight; Paila (H), one; 25 miles southeast of San Pedro de Colonias (I), 42. Durango: Pedricena (J), 10. Sonora: Naco (K), 5000 feet, August 15, 1949 (Bradt), four.

Werner (1949b, p. 110) separated *hirsutipubescens* from *virgulata*, with which it had been synonymized. Neither species has been recorded from Mexico before.

The above specimens are evidently more similar to Werner's west Texas *hirsutipubescens*, since the ground color in all cases is black, not brown as in his southeastern Arizona specimens. In these Mexican specimens the discal stripe on the elytra is not always noticeable. The pubescence is either tan or whitish gray, the number of each in the three states being as follows:

COLOR OF PUBESCENCE IN *hirsutipubescens*

	Tan	Gray
Chihuahua	21	3
Coahuila	67	14
Durango	6	4

The four specimens from Naco, which is virtually southeastern Arizona, have the ground color black, pubescence whitish gray, and the discal stripe very distinct.

Epicauta linearis (LeConte)

Lytta linearis LECONTE, 1858, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4, p. 23.

Macrobasis linearis, HORN, 1873, Proc. Amer. Phil. Soc., vol. 13, p. 94.

TYPE LOCALITY: Llano Estacado (western Texas or eastern New Mexico).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Durango: Pedricena, one.

There have been only a few records of this species in the United States as it is "apparently a very rare species" (Werner, 1945, p. 514). This male is the first and only record from Mexico. Pedricena is in central Durango, near the eastern border.

Epicauta, species unknown

Two black specimens of *Epicauta* were taken at Encino in northern Durango on the 1947 expedition. They were seen by Werner who said they were not *neglecta* Haag, not *nigra* Dugès, and not *pacifica* Maydell, but possibly a new species.

Epicauta, species unknown

Two specimens from Catarinas in southern Chihuahua and five from Encino in northern Durango. These seven specimens agree with Champion's description of *cupreola* Dugès in the "Biologia" (1892, p. 408), but Mr. Werner tells me that he has seen the type of *cupreola* (from Guanajuato) and it is not the same as these specimens. They seem to differ from *rufipedes* (Dugès) only in the black femora and under side and in being smaller and darker above. They also lack the median line of denser pubescence on each elytron, but this is often lacking in *rufipedes*. The hind tibial spurs seem to be the same as in *rufipedes*.

GENUS PLEUROPOMPHA LECONTE

Pleuropompha LECONTE, 1862, Smithsonian Misc. Coll., vol. 3, p. 273.

There are two species in this genus, both of which are here recorded from north central Mexico.

KEY TO THE SPECIES OF *Pleuropompha* IN NORTH CENTRAL MEXICO

Each elytron with four raised ribs, or costae, not counting suture.....*costata*

Each elytron with three raised costae, not counting suture.....*tricostata*

Pleuropompha costata* (LeConte)*Figure 12**

Lytta costata LECONTE, 1854, Proc. Acad. Nat. Sci. Philadelphia, vol. 7, p. 84.

TYPE LOCALITY: "Frontera, Rio Grande" (New Mexico).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: 20 and 25 miles southwest of Camargo (A), 16; 42 miles southwest of Camargo, one; Primavera (B), three; 15 miles east of Parral (C), three. Durango: Villa Madero (D), one.

Neither Champion nor Werner reported this species from Mexico. Six of the above 24 specimens are 14 mm. or less, but the majority are larger, the largest two being 23 mm. (Camargo and Villa Madero). The pubescence is definitely white, except for two specimens in which it is slightly yellowish. The elytral intervals appear gray because of the black ground color showing through the sparse white hairs. The white stripes of the costae are very noticeable.

This and the following species, *tricostata*, occupy about the same range in Mexico, as they do in the United States (Werner, 1943).

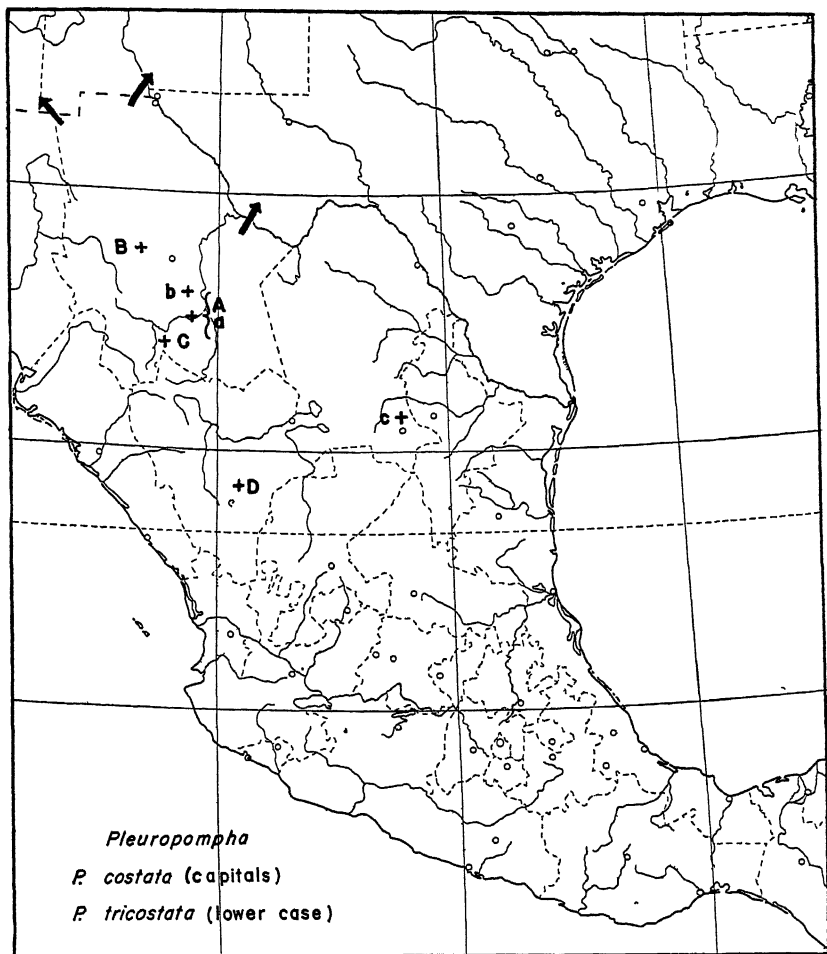


FIG. 12. Distribution of *Pleuropompha costata* (LeConte) and *P. tricostata* Werner.

Pleuropompha tricostata Werner

Figure 12

Pleuropompha tricostata WERNER, 1943, Psyche, vol. 50, pp. 32-33.

TYPE LOCALITY: Presidio, Texas.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: 42 miles southwest of Camargo (a), one; Delicias (b), 10. Coahuila: Guadalupe (c), 22.

This species is generally much smaller and narrower than *costata*, the largest one of the above series being 15 mm. (Guadalupe) and the rest under 15 mm. The pubescence is more evenly distributed than in *costata* and is gray white to yellow, eight of the specimens appearing yellow to the naked eye and 25 appearing gray.

GENUS *LYTTA* FABRICIUS

Lytta FABRICIUS, 1775, *Systema entomologiae*, p. 260.

Cantharis GEOFFROY, 1762, *Histoire abrégée des insectes*, vol. 1, p. 339; *nom. preoccup.*

Tetraolytta PIC, 1919, *L'Echange*, vol. 35, no. 391, p. 3, footnote.

Picella DENIER, 1933, *Bol. Mens. Ministerio Agr. Nac.*, vol. 32, no. 1, p. 37, footnote. New name for *Tetraolytta* Pic.

The genus *Lytta*, as are *Epicauta*, *Zonitis*, and *Meloe*, is found in both the New and the Old World. In the New World about one-third of the species occur in South America, the rest in the United States and Mexico. Of the 28 recorded species from Mexico, only six have so far been taken in the north central region.

The larvae are parasitic in the nests of bees.

The so-called Spanish fly, *Lytta vesicatoria* (Linnaeus), is a member of this genus. It is a large iridescent green and blue species common in much of Europe.

KEY TO THE SPECIES OF *Lytta* IN NORTH CENTRAL MEXICO

1. Outer spur on hind tibiae slender, stick-like, same size as inner spur; large, black..... *suavissima*
Outer spur on hind tibiae broader, much stouter than inner spur..... 2
2. Entirely dull or brassy black above..... *plumbea*
Black and yellow above, or all yellow..... 3
3. Elytra yellow or yellow with black markings..... 4
Elytra black..... 5
4. Elytra shiny, base without black marks; male without any elongated process on last dorsal segment; small (about 10 mm. or less)..... *biguttata*
Elytra dull, opaque, base with two black spots or black band; male with last dorsal segment prolonged into long process; usually large (about 15 mm. or more)..... *quadrinmaculata*
5. Head and thorax red; male with fourth segment of antennae dilated, fifth distorted, sixth normal..... *mutilata*
Head and thorax mostly black; male with antennal segments 4 to 6 slightly thickened..... *intricata*

Lytta mutilata (Horn)

Cantharis (Lytta) mutilata HORN, 1875, *Trans. Amer. Ent. Soc.*, vol. 5, p. 155.

TYPE LOCALITY: Arizona.

RECORDED DISTRIBUTION: *Mexico*. Coahuila: Monclova. Durango: Villa Lerdo.

No specimens examined.

Lytta quadrimaculata (Chevrolat)

Figure 13

Cantharis quadrimaculata CHEVROLAT, 1834, Coléoptères du Mexique, fasc. 4, no. 57.

Cantharis octomaculata PEÑAFIEL Y BARRANCO, 1866, Gaceta Méd. Mexico, vol. 2, p. 225, pl. 1.

Cantharis fasciolata JIMÉNEZ, 1866, Gaceta Méd. Mexico, vol. 2, p. 253, 1 pl.

Cantharis bifasciatus DUGÈS, 1870, La Naturaleza, vol. 1, p. 106, pl. 1, fig. 6.

Cantharis alemani DUGÈS, 1889, Ann. Mus. Michoacano, vol. 2, p. 106.

TYPE LOCALITY: Orixaba [Orizaba].

RECORDED DISTRIBUTION: *Mexico*. Durango: Villa Lerdo (A). San Luis Potosí. Aguascalientes: Aguascalientes City (B). Jalisco: Sayula (C), Guadalajara (D). Colima: Zapotlán (E). Michoacán: Morelia (F), Tacámbaro (G). Nayarit: El Puente (H). Puebla: Matamoros Izúcar (I), Esperanza (J). Distrito Federal: Mexico City (K). Mexico: Toluca (L). Oaxaca: Almolonga (M). Orizaba. Vera Cruz: Perote (N).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Durango: San Lucas (O), one. Jalisco: Zopopam (P), September 11, 1903 (W. L. Tower), three. Puebla: Puebla (Q), August, 1903 (W. L. Tower), one. Hidalgo: Pachuca (R), May 23, 1937 (M. A. Embury), one. Vera Cruz: Jalapa (S), two.

OTHER SPECIMENS EXAMINED: *Mexico*. San Luis Potosí (Dr. Palmer), two. Jalisco: Guadalajara (D), September, 1903 (W. L. Tower), eight. Puebla: Esperanza (J) (Hoege), one. Distrito Federal: Mexico City (K) (Dr. Palmer), one; the following specimens are from the W. L. Tower collection; the localities are under (K) as they are virtually part of Mexico City: Guadalupe, September, 1903, two; Tlapam, July, September, 1903, eight; San Angel, July, August, 1903, two; Santa Fé, September 8, 29, 1903, two; Tlaltenpautla, September, 1903, one. Mexico: Toluca (L), August, 1903 (W. L. Tower), 110.

The markings on the above specimens are quite variable, as is also the size. The smallest specimen (Durango) is only 9 mm., the largest (Distrito Federal) is nearly 25 mm. The thorax usually has two black spots of varying size in the center and two smaller ones on the sides towards the front. In some specimens the

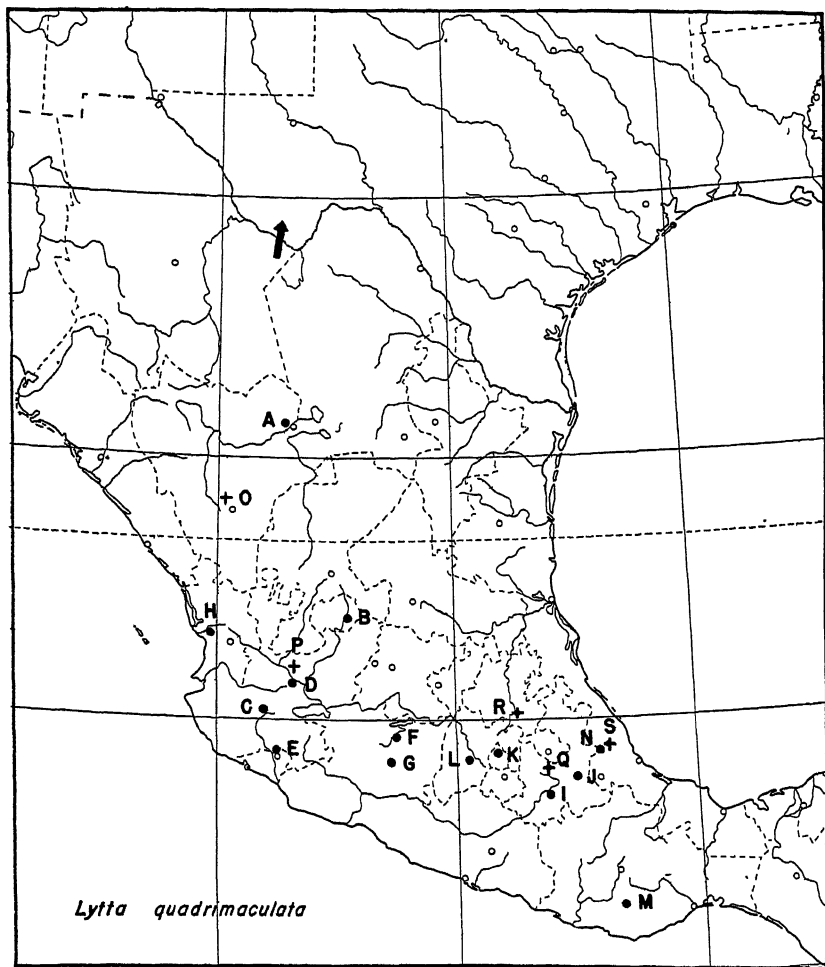


FIG. 13. Distribution of *Lytta quadrimaculata* (Chevrolat).

center spots become elongate into two stripes that reach to the base of the thorax, the stripes occasionally merging across the basal half, as in one of the specimens from San Luis Potosí. This specimen also has more black at the base and apex of the elytra than do any others except the small individual from Durango.

The amount of black on the elytra varies in size and shape, but not geographically. A specimen from Jalisco lacks the basal

markings entirely, but the apical marks are large, almost reaching the apex. The black marks may each cover about a third of the elytra or very much less.

The two specimens from San Luis Potosí and one each from Esperanza and Mexico City are from Godman and were seen by Champion for the "Biologia."

***Lytta intricata* (Champion)**

Cantharis intricata CHAMPION, 1892, Biologia Centrali-Americana, vol. 4, pt. 2, pp. 441-442, pl. 20, figs. 18, 18a.

TYPE LOCALITY: Villa Lerdo in Durango.

Type examined in British Museum.

***Lytta plumbea* Haag**

Lytta plumbea HAAG, 1880, Deutsche Ent. Zeitschr., vol. 24, p. 38.

TYPE LOCALITY: Mexico.

RECORDED DISTRIBUTION: *Mexico*. Durango: Canelas.

No specimens examined.

***Lytta biguttata* LeConte**

Figure 14

Lytta biguttata LECONTE, 1853, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 332.

Cantharis biguttata, HORN, 1873, Proc. Amer. Phil. Soc., vol. 13, p. 109.

Cantharis bivirgata DUGÈS, 1877, La Nature, vol. 5, pp. 140-141.

Cantharis alfredi DUGÈS, 1889, Ann. Mus. Michoacano, vol. 2, p. 98.

TYPE LOCALITY: Santa Fe, New Mexico.

RECORDED DISTRIBUTION: *Mexico*. Durango: Villa Lerdo (A). Guanajuato: Silao (B), Tupátaro (C).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Coahuila: 5 miles north of Saltillo (D), 46; Guadalupe (E), 58; La Rosa (F), five; Paila (G), three; Cabos (H), one; La Gloria, south of Monclova (I), one; San Pedro de Colonias (J), two; 25 miles southeast of San Pedro, one. Durango: San Lucas (K), one; Cuencamé District, Yerbánís (L), one.

In the typical form of this species there are, according to Champion (1892, pp. 445-446), two black oval spots on the elytra about one-quarter from the apex and two small black spots on the thorax. The Saltillo series of 46 specimens are so marked (although the size of the elytral spots varies greatly), except for six specimens

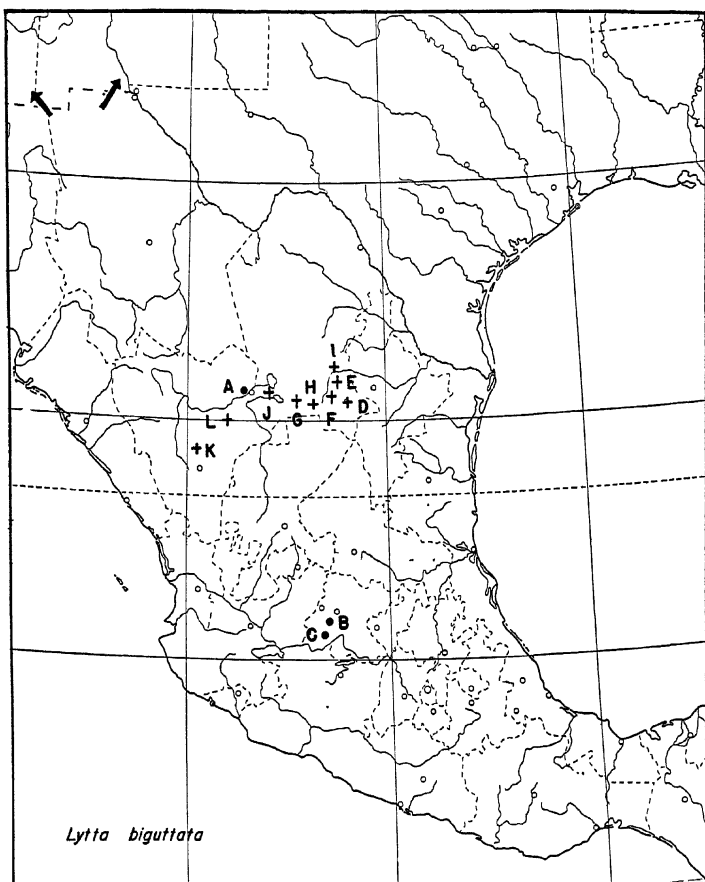


FIG. 14. Distribution of *Lytta biguttata* LeConte.

without any elytral marks and two in which they are so small and faint as to be scarcely visible. The Guadalupe specimens (58) have nine individuals with immaculate elytra and four with the spots scarcely visible; one of the immaculate ones and two others lack the thoracic spots. One from La Rosa has the elytra without marks, one has the black spots covering most of the apical half of the elytra. One of the San Pedro de Colonias specimens also has immaculate elytra.

A specimen from San Pedro and the one from Verbanís have the

thoracic spots prolonged into stripes reaching the base of the thorax, a variation that Champion found in *biguttata* from Guanajuato and one that occurs also in *Lytta quadrimaculata*.

Below, the color varies from black legs to black and yellow, or yellow legs, from black abdomen to black with the last one or two or more segments yellow. The specimens with no black on the elytra usually have less black below.

Lytta suavissima (Wellman)

Cantharis gentilis HORN, 1882-1883, Trans. Amer. Ent. Soc., vol. 10, p. 311.

Lytta suavissima WELLMAN, 1910, Deutsche Ent. Zeitschr., p. 24. New name for *L. gentilis* Horn, nec Frivaldsky, 1877.

TYPE LOCALITY: New Mexico and Arizona.

RECORDED DISTRIBUTION: *Mexico*. Durango: Canelas.

No specimens examined.

GENUS **TETRAONYX** LATREILLE

Tetraonyx LATREILLE, 1805, in Humboldt and Bonpland, Recueil d'observations de zoologie, pp. 237-240, pl. 16, fig. 7.

Picnoseus SOLIER, 1851, in Gay, Historia física y política de Chile, Zoología, vol. 5, p. 281.

Iodema PASCOE, 1862, Jour. Ent., vol. 1, p. 57, pl. 3, fig. 1.

This is a large, New World genus with most of the species occurring in South America and southern Mexico. Two species have been taken in north central Mexico.

KEY TO THE SPECIES OF *Tetraonyx* IN NORTH CENTRAL MEXICO

Head entirely yellow; surface shining.....*fulvus*
 Head piceous in front; surface opaque.....*frontalis*

***Tetraonyx fulvus* LeConte**

Figure 15

Tetraonyx fulva LECONTE, 1853, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 344.

Tetraonyx rufus DUGÈS, 1870, La Nature, vol. 1, pp. 105-106, pl. 1, fig. 7.

TYPE LOCALITY: New Mexico.

RECORDED DISTRIBUTION: *Mexico*. Coahuila: Parras (a). Durango: Villa Lerdo (b). Guanajuato: Irapuato (c), León (d).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: Delicias (e), 40. Durango: Cuencamé District, Yerbánis (f), three.

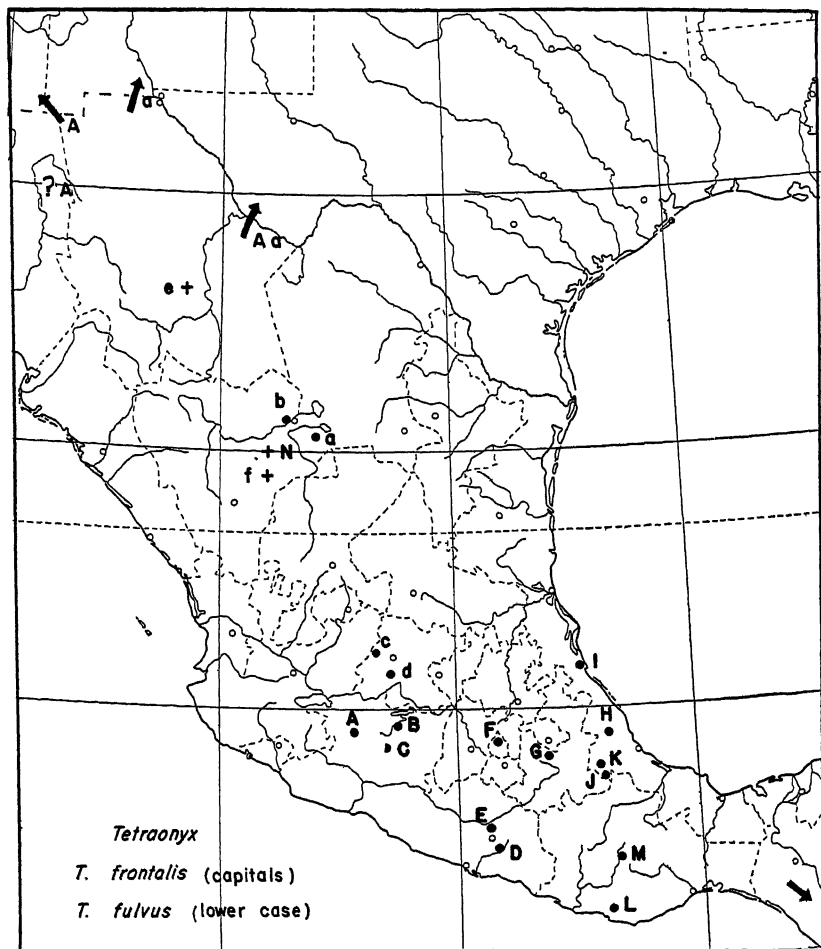


FIG. 15. Distribution of *Tetraonyx fulvus* LeConte and *T. frontalis* Chevrolat.

The specimens from Durango do not seem to differ from the Chihuahua specimens. LeConte said the feet were "not black," but all these have the tarsi black, also the apex of the tibiae and femora, the rest of the legs being yellow.

***Tetraonyx frontalis* Chevrolat**

Figure 15

Tetraonix [sic] *frontalis* CHEVROLAT, 1834, Coléoptères du Mexique, fasc. 1, no 14.

Tetraonyx femoralis DUGÈS, 1870, La Naturelleza, vol. 1, p. 104, pl. 1, fig. 8.

TYPE LOCALITY: Orizaba.

RECORDED DISTRIBUTION: *Mexico*. Northern Sonora. Michoacán: Uruapan (A), Morelia (B), Tacámbaro (C). Guerrero: Mochitlán (D), Amula (E), Xautipa [not located]. Distrito Federal: Mexico City (F). Puebla: Puebla (G). Guanajuato. Vera Cruz: Jalapa (H), Tuxpan (I), Orizaba (J), Córdoba (K). Oaxaca: Juquila (L), Oaxaca (M). *Guatemala*. El Tumbador, San Jerónimo.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Durango: Cuencamé District, Verban's (N), one.

OTHER SPECIMENS EXAMINED: *Mexico*. Guerrero: Amula (E), 6000 feet, August (H. H. Smith), two. Distrito Federal: Santa Fé (F), September 29, 1903 (W. L. Tower), two. Vera Cruz: Jalapa (H) (W. Schaus), four.

The Durango and Santa Fé (Mexico City) specimens have the median third of the middle and hind femora and the basal two-thirds of the front femora yellow as described for *femoralis*. The Jalapa and Guerrero specimens have the entire legs black or piceous. Champion (1892, p. 393) states that the variety "*femoralis* has been received from two localities [Mexico City and Jalapa] in company with the typical form."

GENUS PYROTA DEJEAN

Pyrota DEJEAN, 1833, Catalogue des coléoptères, ed. 2, p. 224.

According to Denier (1934), there are 43 species of *Pyrota*, all in North and South America, a little more than half being found in the United States and Mexico. Nine of the 15 Mexican species occur in the region covered by this study.

KEY TO THE SPECIES OF *Pyrota* IN NORTH CENTRAL MEXICO

1. Elytra black with suture and side margins narrowly yellow or red.....2
Elytra either entirely yellow or yellow with black spots or bands.....3
2. Base of each elytron with incurved longitudinal yellow stripe, apex with yellow subapical spot.....*insulata*
Base of each elytron with transverse yellow stripe, apex margined with yellow but without spot.....*akhurstiana*
3. Elytra without any markings.....4
Elytra with black markings.....5
4. Thorax with four black spots; antennae short, stout.....*quadrinervata*
Thorax with black cross; antennae rather slender.....*nobilis*
5. Hind tibiae with spurs slender, nearly equal; maxillary palpi with apical

- segment narrow, elongate, not concave below (male and female).....
 *rugulipennis*
 Hind tibiae with outer spur spoon shaped, much larger than inner; male
 with apical segment of maxillary palpi broad, either pear shaped or
 strongly transverse, and concave below, female with it narrow, elongate,
 not concave below.....6
 6. Elytra with three broad transverse bands of about equal size 7
 Elytra with two or three transverse bands, often broken into spots, but the
 postmedian band or spots larger than the basal band or spots, or merging
 with them.....8
 7. Male (palpi greatly enlarged) with third antennal segment equal to or shorter
 than fourth.....*mylabrina*
 Male (palpi greatly enlarged) with third antennal segment longer than
 fourth.....*palpalis*
 8. Elytra with black lunate mark or spot at extreme apex; thorax with only
 two black spots; eyes broader, reaching about halfway to back of head
 (seen from side).....*punctata*
 Elytra without any mark at extreme apex; thorax with four black spots
 (rarely the two side spots lacking); eyes narrower, reaching less than half-
 way to back of head.....*postica*

***Pyrota akhurstiana* Horn**

Pyrota akhurstiana HORN, 1891, Trans. Amer. Ent. Soc., vol. 18, p. 44, pl. 1, fig. 9.

TYPE LOCALITY: Tucson, Arizona.

RECORDED DISTRIBUTION: *Mexico*. Northern Mexico.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: Delicias, 193; 10 miles south of Delicias, 200; Valle de Olivos, 12; 20 miles southwest of Camargo, three; 42 miles southwest of Camargo, one; Santa Bárbara District, Santa Bárbara, 24; 63 miles west of Santa Bárbara, 14.

Champion had seen but one specimen of this species which was taken by the expedition in 1947 in such abundance. The red margins on the suture and on the border of the elytra are wider in some specimens, but always present. The red spot at the base of the thorax is lacking or reduced in many specimens from different localities; in two specimens (10 miles south of Delicias) the basal and apical marks are fused into a red stripe; occasionally there are extra spots in front of the lateral mark. The size range is from 15 to nearly 30 mm.

The new localities are in southern Chihuahua.

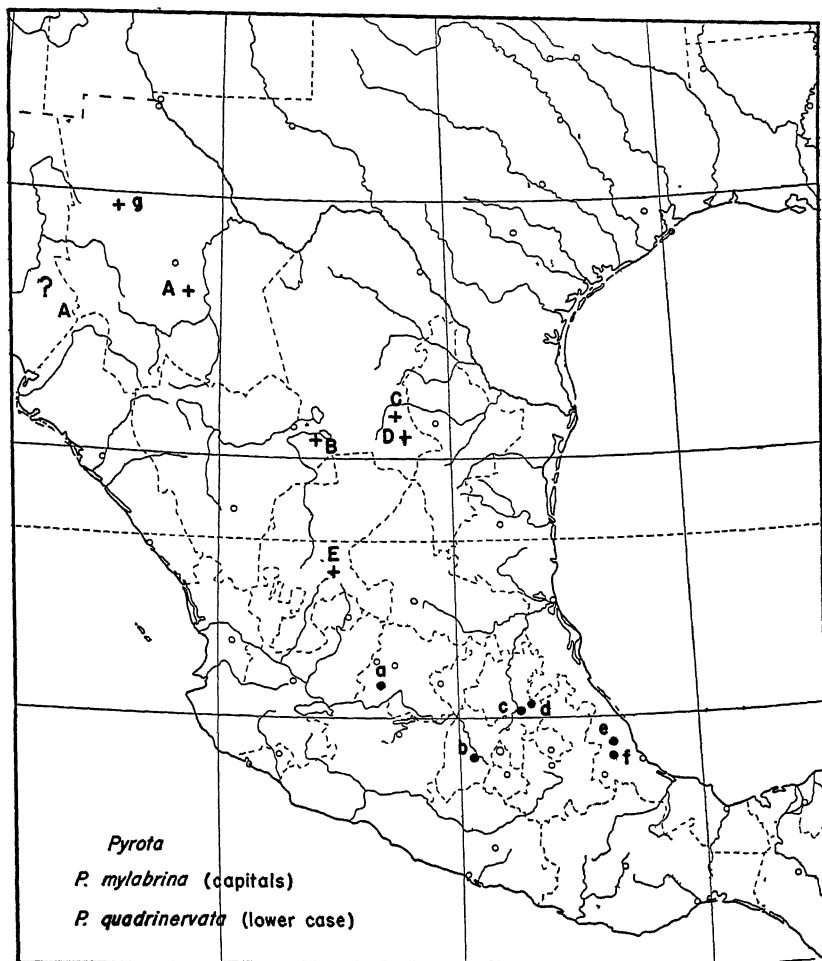


FIG. 16. Distribution of *Pyrota mylabrina* Chevrolat and *P. quadrinervata* (Herrera and Mendoza).

***Pyrota insulata* (LeConte)**

Lytta insulata LECONTE, 1858, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4, p. 22.

TYPE LOCALITY: Texas.

RECORDED DISTRIBUTION: *Mexico*. Durango: Villa Lerdo.

No specimens examined.

***Pyrota mylabrina* Chevrolat**

Figure 16

Pyrota mylabrina CHEVROLAT, 1834, Coléoptères du Mexique, fasc. 3.

TYPE LOCALITY: Tuxpan [Tuxpan].

RECORDED DISTRIBUTION: *Mexico*. Coahuila: San Pedro.NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Sonora (C. Lumholtz), one. Chihuahua: Delicias (A), three. Coahuila: San Pedro de Colonias (B), one; La Rosa (C), two; 5 miles north of Saltillo (D), one. Zacatecas: Fresnillo (E), five.

The type locality might have been in Nayarit, Jalisco, Michoacán, or Vera Cruz, since Chevrolat did not mention the state, and there is a Tuxpan in each of these states.

Champion's remark (1892, p. 430) that this species "varies but little in elytral markings" holds true for the above specimens. In the Sonora specimen, however, the thorax lacks the four black spots. Below, there is some variation in color, about half of the specimens having the metasternal region and abdomen black but the abdominal segments with yellow apical bands, the others having the metasternum mostly yellow and the abdomen as above, or the metasternum black but the abdomen more yellow than black.

Pyrota nobilis* (Haag)Lytta nobilis* HAAG, 1880, Deutsche Ent. Zeitschr., vol. 24, pp. 48-49.

TYPE LOCALITY: Mexico.

RECORDED DISTRIBUTION: *Mexico*. Durango: Canelas. Colima: Tonila. Oaxaca.

No specimens examined.

Pyrota palpalis* ChampionPyrota palpalis* CHAMPION, 1893, Biologia Centrali-Americana, vol. 4, pt. 2, suppl., pp. 462-463.

TYPE LOCALITY: Mexico; here designated as Villa Lerdo, Durango, from original label on type.

RECORDED DISTRIBUTION: *Mexico*. Chihuahua: Chihuahua City. Durango: Villa Lerdo. Nuevo León: Monterrey.

Type examined in British Museum.

***Pyrota postica* LeConte**

Pyrota postica LeConte, 1866, Smithsonian Misc. Coll., vol. 6, no. 167, p. 160.
Lytta plagiata Haag, 1880, Deutsche Ent. Zeitschr., vol. 24, pp. 49-50.

TYPE LOCALITY: Texas and New Mexico.

RECORDED DISTRIBUTION: *Mexico*. Durango: Villa Lerdo. Nuevo León: Monterrey. Jalisco: Ahualulco.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: San José Babicora, 150; Santa Bárbara District, Santa Bárbara, four.

The elytra in the typical form, as described by Champion (1892, p. 431), have the black postmedian spot large and quadrangular. This type is well represented in the above series, but 18 specimens have the spot much elongated and merging with the basal spots until the elytra are nearly all black. The four specimens from Santa Bárbara have the four basal elytral spots distinctly separated, which occurs in the minority of San José Babicora specimens where the spots are either partly or entirely fused. All specimens have the femora and tibiae yellow with the tips black.

From San José Babicora in northern Chihuahua to Villa Lerdo in central eastern Durango is about as far as from Villa Lerdo to Ahualulco in Jalisco.

***Pyrota punctata* Casey**

Pyrota punctata Casey, 1891, Ann. New York Acad. Sci., vol. 6, pp. 173-174.

TYPE LOCALITY: Western Texas.

RECORDED DISTRIBUTION: *Mexico*. Coahuila: San Pedro. Durango: Villa Lerdo.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Coahuila: San Pedro de Colonias, two; Torreón, June 14, 1937 (M. A. Embury), one.

In one of the San Pedro de Colonias specimens a black line joins the middle band to the apical lunule near the outer margin, and the lunule covers a much larger area than in the other specimen. The Torreón specimen has the apical lunule large but not joining the middle band. One of Casey's three specimens showed a tendency to the prolongation of the lunule. Villa Lerdo, San Pedro de Colonias, and Torreón are in close proximity. Champion's "San Pedro" might be any one of the five San Pedro's in Coahuila.

***Pyrota quadrinervata* (Herrera and Mendoza)**

Figure 16

Cantharis quadrinervata HERRERA AND MENDOZA, 1866, Gaceta Méd. Mexico, vol. 2, p. 265, fig. 2 on pl.

TYPE LOCALITY: Mexico.

RECORDED DISTRIBUTION: *Mexico*. Guanajuato: Tupátaro (a). Mexico: Toluca (b). Hidalgo: Pachuca (c), Real del Monte (d), Mineral del Chico [not located]. Vera Cruz: Jalapa (e), Coatepec (f).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: San José Babícora (g), five.

The Chihuahua record is far to the north of the recorded range, but this is quite a distinctive insect, though evidently not common.

Champion (1892, p. 436) says that this species varies in the color of the legs and under side. This is borne out in one of the above specimens which has a yellow orange narrow band at the apex of the first four abdominal segments, whereas the others lack this band. In all five specimens the femora and tibiae at the apex and all the tarsi are piceous; the under side is also piceous, except for the last two abdominal segments which are yellow.

***Pyrota rugulipennis* Champion**

Pyrota rugulipennis CHAMPION, 1892, Biologia Centrali-Americana, vol. 4, pt. 2, p. 431, pl. 20, figs. 4-4d.

TYPE LOCALITY: Canelas in Durango.

Type examined in British Museum.

GENUS *MELOE* LINNAEUS

Meloe LINNAEUS, 1758, Systema naturae, ed. 10, vol. 1, p. 419.

Proscarabeus STEPHENS, 1832, Illustrations of British entomology, Mandibulata, vol. 5, p. 65.

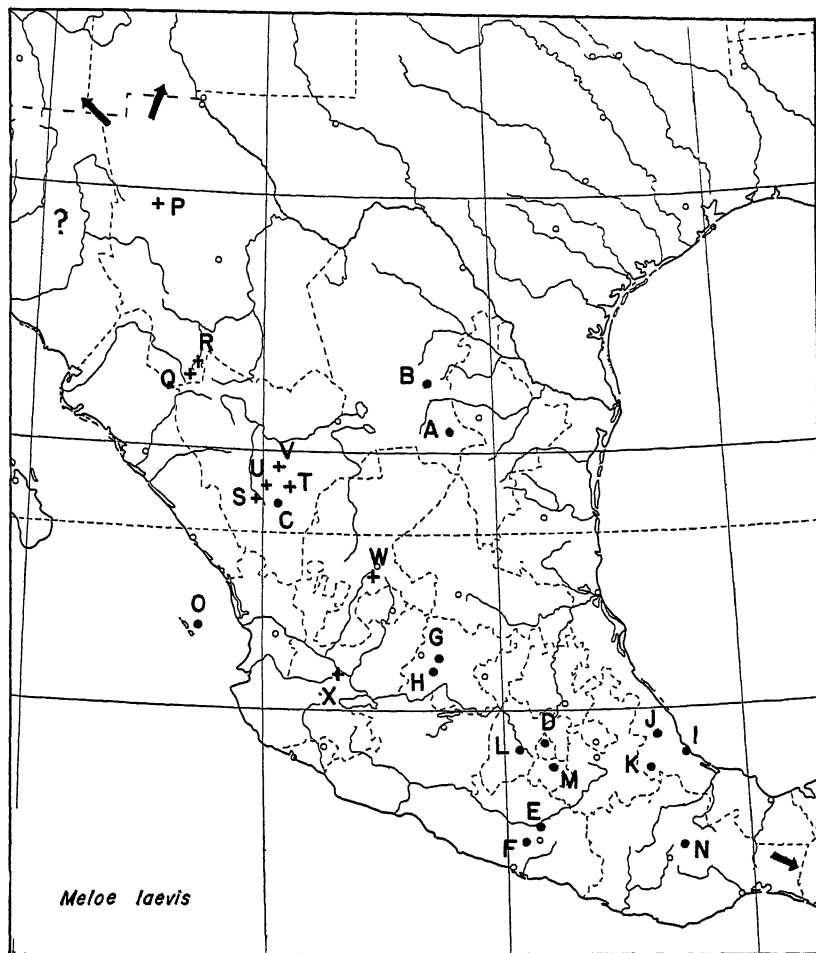
Cnestocera THOMSON, 1864, Skandinaviens Coleoptera, vol. 6, p. 342.

Treidous DUGÈS, 1870, La Nature, vol. 1, p. 102.

Of the four species occurring in Mexico, two have been taken in north central Mexico. The genus is characteristic of more northern, temperate zones, and in Mexico it is found in the highlands (Champion, 1892, p. 364). It occurs in the Old World as well.

KEY TO THE SPECIES OF *Meloe* IN NORTH CENTRAL MEXICO

Antennae gradually increasing in thickness to apex (male and female) . . . *laevis*

FIG. 17. Distribution of *Meloe laevis* Leach.

Antennae gradually increasing in thickness to sixth segment, then decreasing in thickness to apex (female), the sixth and seventh segments widely dilated and flattened (male).....*dugesi*

Meloe laevis Leach

Figure 17

Meloe laevis LEACH, 1815, Trans. Linnean Soc. London, vol. 11, pp. 249-250, pl. 18, fig. 4.

Meloe cordillerae CHEVOLAT, 1829-1844, in Guérin, Iconographie du règne animal, vol. 3, p. 133, pl. 35, fig. 6.

Meloe sublaevis LeConte, 1854, Proc. Acad. Nat. Sci. Philadelphia, vol. 7, p. 84.

Meloe tucci Peñafiel y Barranco, 1866, Gaceta Méd. Mexico, vol. 2, p. 227.

Meloe tridentatus Jiménez, 1866, Gaceta Méd. Mexico, vol. 2, p. 230.

Treiodus barranci Dugès, 1870, La Nature, vol. 1, p. 102, pl. 1, figs. 1-2.

Meloe opaca Motschulsky, 1873, Bull. Soc. Imp. Nat. Moscou, vol. 45, pt. 2, p. 48.

Treiodus cordillerae Dugès, 1889, Ann. Mus. Michoacano, vol. 2, p. 35.

TYPE LOCALITY: "Insulâ Americe St. Domingo."

RECORDED DISTRIBUTION: *Mexico*. Sonora. Coahuila: Saltillo (A), Monclova (B). Durango: Durango City (C). San Luis Potosí. Distrito Federal: Mexico City (D). Guerrero: Amula (E), Omilteme (F), Xautipa [not located]. Guanajuato: Guanajuato (G), Silao (H). Vera Cruz: Vera Cruz (I), Jalapa (J), Orizaba (K). Mexico: Toluca (L). Morelos: Cuernavaca (M). Oaxaca: Capulalpam (N). Mexico or Jalisco?: Atotonilco. Peras, Parada, Santecomapan [not located]. Tres Marias Islands (O) (Van Dyke, 1928, p. 447). *Guatemala*. Escuintla, San Jerónimo, San Joaquín, Tepan, Cobán, Aceytuno. *Nicaragua*. *Costa Rica*.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: San José Babícora (P), two; Balleza (Q), one; Santa Bárbara District, Santa Bárbara (R), four. Durango: Palos Colorados (S), three; Villa Madero (T), two; San Lucas (U), one; San Juan del Rio (V), 11. Zacatecas: Zacatecas District, Guadalupe (W), seven. Jalisco: "Envir de" Guadalajara (X), 1901 (M. Diguët), 11.

OTHER SPECIMENS EXAMINED: *Mexico*. Vera Cruz: Jalapa (J) (Hoege), one, (W. Schaus), four. Near Mexico City: Teotihuacán (D), July 18, 1947 (Malkin), one.

Among these specimens are some with the elytra quite smooth and others with them rugose or longitudinally wrinkled, as Champion (1892, p. 367) noticed in the large series he examined. The size varies from 13 to 40 mm. Some of the small ones have the abdomen uninflated (or shriveled?) but the head, thorax, and elytra show by their size that they are much longer insects.

Meloe dugèsi Champion

Figure 18

Meloe dugèsi Champion, 1892, Biologia Centrali-Americana, vol. 4, pt. 2, p. 366, pl. 17, figs. 2, 2a.

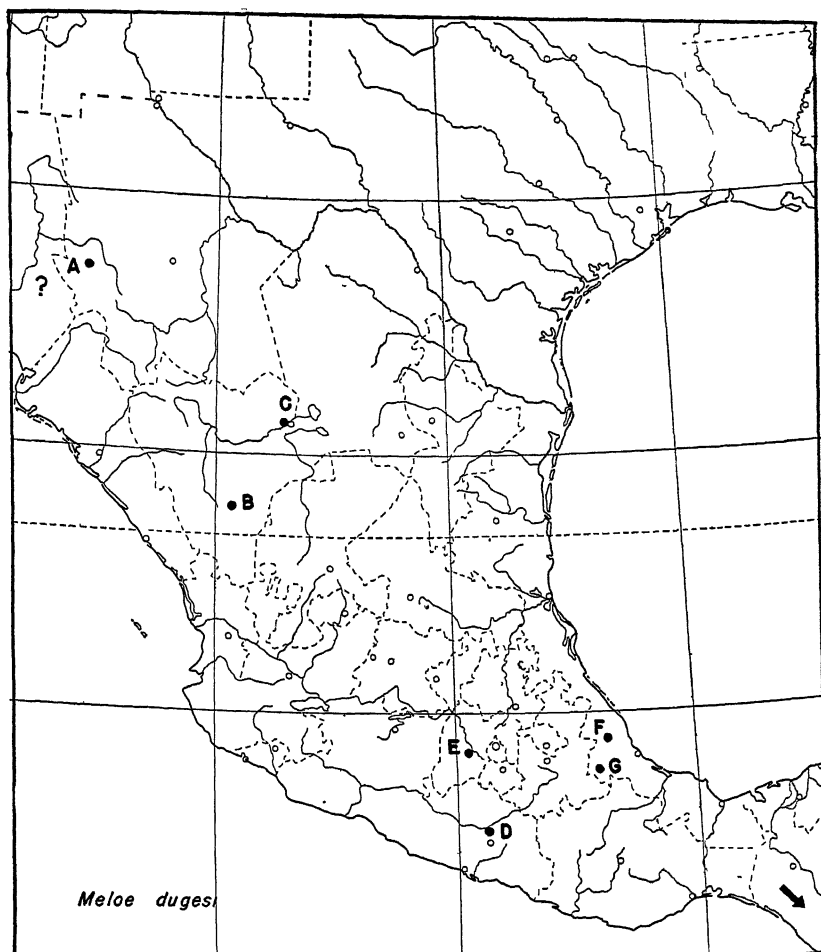


FIG. 18. Distribution of *Meloe dugesi* Champion.

TYPE LOCALITY: Not given; here designated as Pinos Altos, Chihuahua, from original label on type, examined in British Museum.

RECORDED DISTRIBUTION: *Mexico*. Chihuahua: Pinos Altos (A). Durango: Durango City (B), Villa Lerdo (C). Guerro: Amula (D). Mexico: Toluca (E). Vera Cruz: Jalapa (F), Córdoba (G). *Guatemala*: Tepan.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Sonora (C. Lumholtz), one.

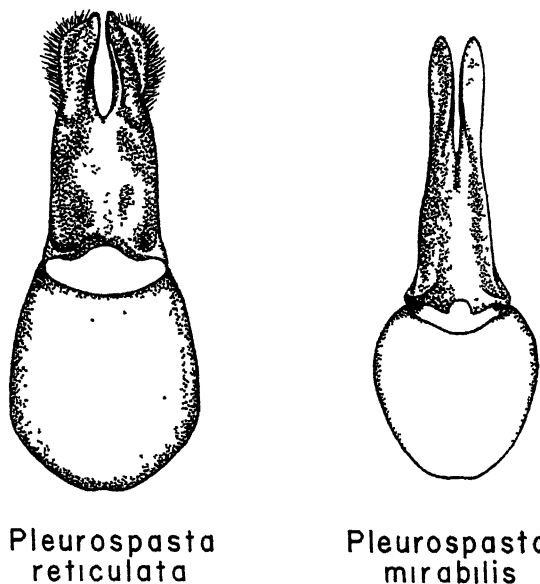


FIG. 19 Male genitalia, dorsal view, of *Pleurospasta reticulata* Van Dyke and *P. mirabilis* Horn.

OTHER SPECIMENS EXAMINED: Jalapa (F) (W. Schaus), one.

These specimens are both males, with the fifth to seventh antennal segments dilated and distorted.

GENUS PLEUROSPASTA WELLMAN

Pleurospasta WELLMAN, 1909, Ent. News, vol. 20, p. 20.

With the elevation of *P. mirabilis reticulata* to species status, there are now two species in the genus, only one of which has been reported from north central Mexico.

Pleurospasta reticulata Van Dyke

Figure 19

Pleurospasta mirabilis reticulata VAN DYKE, 1947, Pan-Pacific Ent., vol. 23, pp. 157-158.

TYPE LOCALITY: Loving, New Mexico.

RECORDED DISTRIBUTION: *Mexico*. Tamaulipas: Nuevo Laredo (Van Dyke, 1947, p. 157). Coahuila. (*Fide* figure in Champion, 1892, p. 394, pl. 18, fig. 12, under *P. mirabilis*.)

No specimens of this species from Mexico were examined, but

examination of a series of 83 specimens from White City, Eddy County, New Mexico, shows that the differences between *P. mirabilis* and *P. reticulata* are not merely subspecific, but specific, which are included in the comparison below.

DIFFERENCES BETWEEN *Pleurospasta reticulata*
AND *P. mirabilis*

	<i>P. reticulata</i>	<i>P. mirabilis</i>
General color of markings	Blood red mixed with black	Brown to pale red, no black
Head	Less convex between antennae and not suddenly depressed behind; margin of back of head oval	Very convex between antennae and suddenly depressed behind; margin of head round
Hind margin of clypeus	Straight to feebly rounded	Feebly rounded to strongly convex
Third segment of male antennae	Same width throughout, not excavated on inner side	Narrower at base because of slight excavation on inner side
Surface of head and thorax	Shining; deeply, irregularly punctured	Opaque; nearly smooth, punctures not visible or few in number
Base of thorax	Prominently bulbous	Feebly convex
Elytral pattern:		
Basal spots	Two to five, usually two; usually smaller	Four or more, usually four; usually larger
Postmedian band	Pattern irregular but not zigzag; broader; color blood red with black borders, or red and black	Pattern zigzag or like double V's; narrower; color brownish to pale reddish
Apical band	Blood red edged with black at front, band always reaching apex	Brown or pale red without black at front, band usually not reaching apex
Costae	Merging in postmedian band and with numerous strongly raised cross ribs	Continuing straight to near apex, not merging in postmedian band, but with occasional feebly raised cross ribs
Male front first tarsal segment	With hairy pad from base to apex	With hairy pad at apex only
Male genitalia, dorsal side	Lateral lobes excavated internally towards apex; lobes robust, and with hairs on sides near	Lateral lobes straight, nearly parallel, not excavate; lobes slender, without hairs

All the above characters except the general color and the elytral pattern seem to indicate the specific distinctness of *P. reticulata* even though the distribution, as given by Van Dyke, is allopatric. Other characters not given before and not listed above are:

Head sparsely but deeply and irregularly punctured, with a median groove from near base to apex and a slight, shallow depression near the base, neither being always well marked. Clypeus and labrum of about equal size, labrum with front margin rounded. Maxillary and labial palpi with last segment small, elongate. Eyes small, not prominent, elongate oval, one-third longer than broad. Antennae slender, reaching just beyond the base of the thorax in the male, not quite to the base in the female, closely segmented, the articulations not visible, first two segments with a few stiff, dark setae, first segment stout, half the length of third, second about half the length of first, third and following segments covered with fine dense pale hairs and of equal width throughout, third segment one-third longer than fourth, fourth and following segments the same length, except the last which is slightly longer. Thorax bilobed, with deep median line and basal and apical transverse depressions, constricted and much narrower in apical half, each basal bulbous lobe with a deep, sometimes shallow, depression in the center, thorax about as long as wide (though it appears longer than wide), irregularly punctured and rugose. Elytra four times longer than thorax, nearly parallel, two-thirds wider at base than thorax, with four strongly raised costae, the suture and side margins also costate, each interspace between the costae interrupted postmedially (in the area of the red and black band of color), by one or more than one red transverse costa or rib; at the apex the costae are again interrupted and connected with each other and with the margins, surface of elytra with short, dark, stiff setae, widely scattered. Below, apex of abdomen triangularly emarginate in the male, rounded in the female. Legs slender, hairy, the femora with short, fine, white hairs, the tibiae and tarsi with dark, coarse setae intermingled with the hairs, the apex of the tibiae with two slender, tapering spurs, the outer one on the front tibiae slightly longer than the inner and curving outward, on the other tibiae the outer spur shorter than the inner one and both spurs straight; front tarsi below with no hairy pad in the female. Claws toothed, the tooth a little more than half the length of the claw. Length: 7-12 mm. (measured from top of head with head deflexed).

The 83 specimens from White City show considerable variation in the elytral pattern and in the conformation of the cross ribs. The basal dark spots, while two in number and situated in the second interspace in 82 per cent of the specimens, vary from one to five in the other specimens and are occasionally placed in the first interspace. The spots are usually black, sometimes reddish, elongate or round, usually smaller than a pinhole, and in a few specimens are visible only under the microscope.

The middle band is usually mostly red, with the borders edged with black to a varying degree, but 27 specimens have more black than red. In either case, however, the raised ribs are always red.

As to the cross ribbing, in the first interspace postmedially there may be one to four cross ribs, feebly or strongly raised, sometimes more on one elytron than on the other, but always present; the first and second costae (not counting the suture) may meet in the postmedian band of color either in a sharp point or at an angle or in a square. Sometimes little extra cells are formed where two ribs meet.

The New Mexican series was taken June 20, 1948, by M. Cazier, in an area approximately 50 feet wide by 150 feet long, bordered on one side by the main highway to Carlsbad Caverns and on the other by a section of White's Auto Court in White City, New Mexico. No specimens were collected outside this area, although they were looked for elsewhere in the vicinity. The area was primarily sand, with a small amount of gravel, and was sparsely vegetated with low annuals with very little grass intermixed.

Although their elytral pattern is somewhat mottled in appearance the beetles were not cryptically colored and were easily detected as they ran from plant to plant, upon which, however, they did not appear to be feeding. None were observed flying, in spite of the fact that they have well-developed wings, nor did they make any attempt to fly when chased either by other specimens or by the collector, even though at this time the temperature was very high. They were very rapid and erratic in their behavior, much like ants which they somewhat resembled. There were many ant nests in the area, but the beetles, while seen running over the ant hills, were not observed entering or leaving the holes nor were they molested by the ants.

GENUS *EUPOMPHA* LECONTE

Eupompha LeConte, 1858, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4, p. 21.

The following is the only species in the genus.

Eupompha fissiceps LeConte

Eupompha fissiceps LeCONTE, 1858, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4, p. 21.

TYPE LOCALITY: Llano Estacado, Texas.

RECORDED DISTRIBUTION: *Mexico*. Coahuila. Durango. Villa Lerdo.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Coahuila: Guadalupe, two. Chihuahua: 42 miles southwest of Camargo, one.

The male of this brilliantly iridescent green meloid not only has its red head virtually cleft in two from base to apex, but has the first three tarsal segments on the front legs dilated and distorted and the front tibiae distorted and sinuous. The depression in the head of the female is much shallower but extends also from base to apex.

This species is very abundant in Texas. The new localities are in the southeastern part of their respective states.

GENUS **CYSTEODEMUS** LeCONTE

Cysteodemus LeCONTE, 1851, Ann. Lyc. Nat. Hist. New York, vol. 5, p. 158.

Only one of the two species of this genus has been recorded from north central Mexico.

Cysteodemus wislizeni LeConte

Cysteodemus wislizeni LeCONTE, 1851, Ann. Lyc. Nat. Hist. New York, vol. 5, p. 158.

TYPE LOCALITY: New Mexico.

RECORDED DISTRIBUTION: *Mexico*. Chihuahua. Durango: Villa Lerdo.

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: 42 miles southwest of Camargo, nine. Coahuila: Guadalupe, six; San Pedro de Colonias, one; Cabos, two.

OTHER SPECIMENS EXAMINED: *Mexico*. Durango: Villa Lerdo (Höge), one.

The size variation in this material is from 9 mm. to 18 mm. Eight of the specimens are purple, the remainder blue green. The Villa Lerdo specimen is one of Godman's, probably seen by Champion.

Camargo is in southeastern Chihuahua, and the other new localities are in southern Coahuila.

GENUS *MEGETRA* LECONTE

Megetra LeConte, 1859, in Thomson, *Arcana naturae*, vol. 3, p. 127, pls. 12-13.

Both species of this genus have been recorded from north central Mexico.

KEY TO THE SPECIES OF *Megetra* IN NORTH CENTRAL MEXICO

1. Labrum with front margin emarginate; each elytron with a well-defined reddish stripe on dorsal surface reaching about three-quarters of the way to the apex; deflexed margin of elytra with large, deep, fairly regularly placed pits as on elytra above.....*vittata*
 Labrum with front margin not emarginate; each elytron with a maze of reddish reticular markings on dorsal surface, or with an irregular, ramifying reddish stripe reaching to apex; deflexed margin of elytra with a few small, shallow pits in the irregularly rugose surface, not as in elytra above 2
2. Dorsal surface of elytra entirely covered with reddish reticular markings; elytra shorter in both sexes.....*cancellata cancellata*
 Dorsal surface with reddish reticular markings obliterated towards suture, usually forming an irregular, ramifying stripe; elytra longer in both sexes*cancellata championi*

Megetra cancellata cancellata (Brandt and Erichson)

Figure 20

Meloe cancellatus BRANDT AND ERICHSON, 1832, *Nova Acta Leopoldina*, vol. 16, p. 141, pl. 8, fig. 9.

Cysteodemus cancellatus LeConte, 1854 (1856), *Proc. Acad. Nat. Sci. Philadelphia*, vol. 7, p. 224.

Megetra cancellata hoegei DUGÈS, 1889, *Ann. Mus. Michoacano*, vol. 2, pp. 39-40.

TYPE LOCALITY: Mexico.

RECORDED DISTRIBUTION: *Mexico*. Hidalgo: Tula (a), Pachuca (b).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Durango: Villa Madero (c), 19.

OTHER SPECIMENS EXAMINED: *Mexico*. Hidalgo: Pachuca (b) (Höge), one, July 12, 1935, July 4, 1937 (K. L. Maehler), two.

These specimens have the elytra entirely covered with a network of orange red lines. The 12 males and eight females are

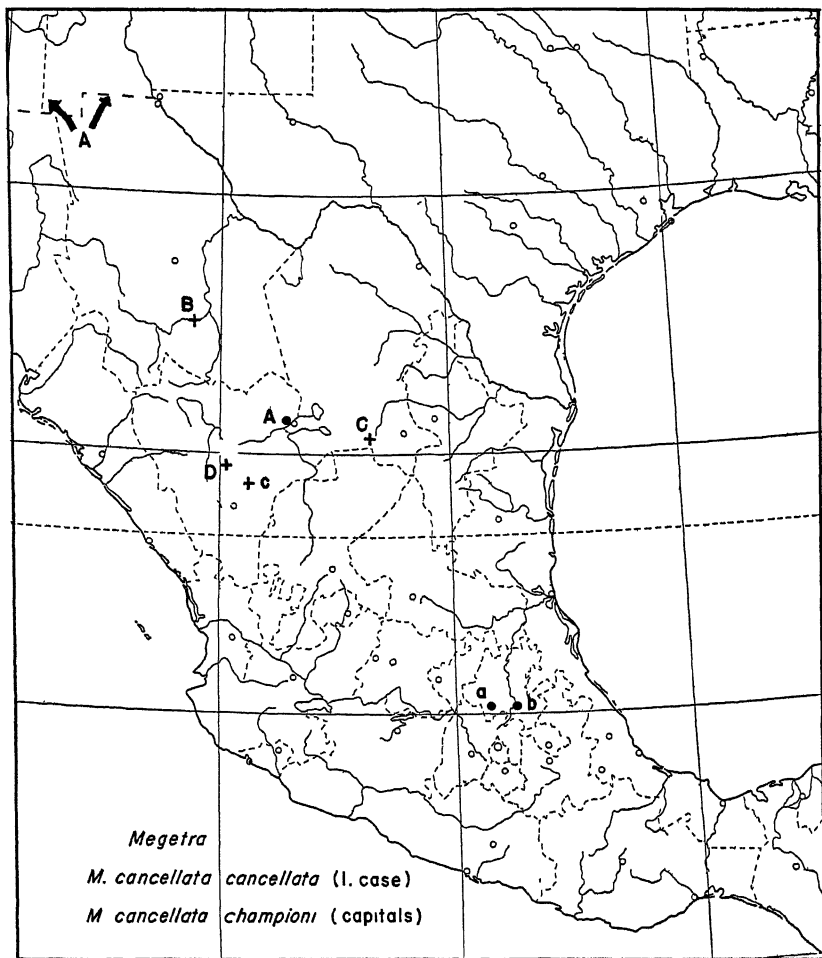


FIG. 20. Distribution of *Megetra cancellata cancellata* (Brandt and Erichson) and *M. c. championi* Van Dyke.

similar except in the shape of the last abdominal segment which is deeply cut out in the male and rounded in the female. The elytra reach to, or usually beyond, the hind margin of the first abdominal segment, sometimes nearly to the hind margin of the second segment. The Hidalgo specimens do not differ from the northern ones. Further collecting should produce more specimens from the area between these widely separated localities.

***Megetra cancellata championi* Van Dyke**

Figure 20

Megetra cancellata championi VAN DYKE, 1928, Univ. California Publ. Ent., vol. 4, no. 12, pp. 456-457.

TYPE LOCALITY: Mexico.

RECORDED DISTRIBUTION: *Mexico*. Durango: Villa Lerdo (A).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: 42 miles southwest of Camargo (B), six. Coahuila: Cabos (C), two. Durango: San Lucas (D), one.

Champion (1892, p. 370) described and figured this subspecies as a variety of *cancellata*, but gave it no name. It is more northern than nominate *cancellata*, occupying the same geographical range as *M. vittata*, with which it might be confused at first glance. The two Durango localities, San Lucas and Villa Lerdo, are, respectively, about 40 and 100 miles north of Villa Madero, Durango, where nominate *cancellata* was taken. Champion mentioned that Höge collected both forms "in widely-separated localities and not intermixing." (The San Lucas locality is not the better known San Lucas from the extreme southern corner of Durango.)

The elytra in this subspecies are longer than in either *M. vittata* or nominate *cancellata*, reaching at least to the hind border of the second abdominal segment. Eight of the above specimens, four males and four females, have the abdomen so shriveled that the elytra cover it entirely, giving them quite a different appearance from the two specimens with the abdomen normally enlarged.

***Megetra vittata* (LeConte)**

Figure 21

Cysteodemus vittatus LECONTE, 1853, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 330.

TYPE LOCALITY: New Mexico.

RECORDED DISTRIBUTION: *Mexico*. Chihuahua: Pinos Altos (A), Chihuahua City (B). Durango: Villa Lerdo (C).

NEW LOCALITIES AND SPECIMENS EXAMINED: *Mexico*. Chihuahua: 42 miles southwest of Camargo (D), 155; Santa Bárbara District, Santa Bárbara (E), eight; Catarinas (F), one; Valle de Olivos (G), one. Coahuila: 25 miles south of San Pedro de Colonias (H), three. Durango: Durango District, 6 miles north-east of El Salto (I), two.

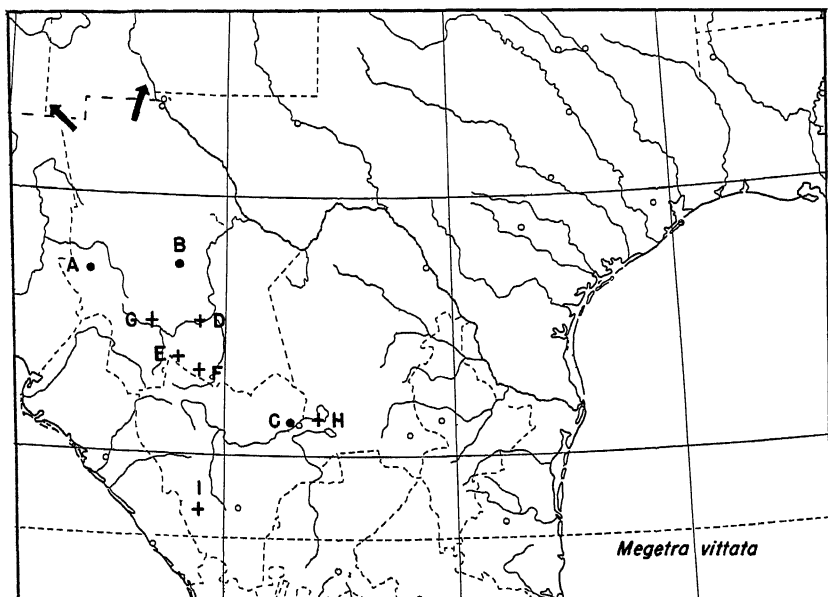


FIG. 21. Distribution of *Megetra vittata* (LeConte).

OTHER SPECIMENS EXAMINED: *Mexico*. Chihuahua: Pinos Altos (A) (Buchan-Hepburn), one.

This species, according to the data and material available, occupies about the same geographical range as *cancellata championi*. It seems, however, far more abundant. Both species were taken in 1947 at Camargo and Santa Bárbara in Chihuahua in the proportion of 162 *vittata* to seven *cancellata championi*. Champion (1892, p. 370) reported both from Villa Lerdo in Durango. Neither form has been reported from so far south as nominate *cancellata* from Hidalgo and Villa Madero, Durango.

The males have the same enlarged abdomens as the females, but differ from them in the shape of the last abdominal segment which is cut out, or triangularly emarginate, although not so deeply as in male *cancellata*. The elytra reach about to the hind border of the first abdominal segment.

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VARIABILITY IN *CHLOEPHAGA PICTA*

BY JEAN DELACOUR

Magellan Shelgeese are the most abundant and widespread of the five species of *Chloephaga*, a peculiar goose-like genus inhabiting the colder parts of South America. Although still present in vast numbers in Patagonia, southern Chile (where they nest as far north as Laguna Las Truchas, Cordillera de Neuble, at 6000 feet in altitude), Tierra del Fuego, Cape Horn Islands, and the Falkland Islands, despite ruthless persecution by sheep farmers, they have been so far insufficiently studied. Their variations, distribution, movements, and life habits still are imperfectly known.

The sexes differ considerably in *Chloephaga picta*. The larger male is predominantly white on the head and neck, whereas the female is ruddy chestnut. The taxonomy of the species has long remained in a state of confusion. It had up to now been thought that all females were alike, although males showed two phases of color, some being pure white on the breast and abdomen, while others are thickly barred with black right across the under parts. Various authors have considered them as two species, others as subspecies, but it was always evident that they were not satisfactorily segregated geographically. White-bellied or barred males occur more or less exclusively in certain parts of the range, while they are mixed to a greater or lesser degree in others; also intermediate specimens exist. Among the latest reviewers, Hellmayr (The birds of Chile, 1932, Chicago, pp. 319-321) recognizes a single species (*picta*), stating, "There can be little doubt in my mind that the two recognized 'species' of Upland Goose, *C. 'magellanica'* and *C. 'inornata'* (or *dispar*), are either merely individual mutants or ill-segregated local races." Conover, however (Birds of the Americas, 1948, Chicago, vol. 1, no. 2, pp. 309-311),

recognizes *dispar* as a subspecies of *picta*, for the barred birds with some misgivings, "From our present knowledge it is impossible to decide whether the so-called Barred Upland Goose is a colour phase, a subspecies, or perhaps even a full species."

In the preparation of a general work on the waterfowls of the world in which I am now engaged, I have had to elucidate the question as well as I could. Fortunately there are large series of *Chloephaga picta* in the American Museum, the majority collected by R. H. Beck between 1912 and 1916, which are very instructive. I also have gathered interesting information from other collectors and observers and from the literature.

The first striking fact that the examination of our series has brought to light is the distinct difference that exists between the populations of the Falkland Islands and those of the mainland of South America, Tierra del Fuego, and neighboring islands. The Falkland birds are considerably larger, as shown by the following measurements for adult birds:

	WING		TARSUS		BILL	
	♂	♀	♂	♀	♂	♀
Falkland Islands	462	418	93	87	43-45	40-41
	450	405	92	75		
	435	417	92	85		
	440	418	95	90		
	437	423	92	84		
		416		82		
		400		85		
		429		86		
Tierra del Fuego and neighboring islands and the Straits of Magellan	400	403	78	78	34-38	33-36
	404	384	72	75		
	408	382	76	77		
	424	384	77	75		
	411	402	80	73		
	397	368	76	78		
	405	390	75	72		
		380		75		
		382		72		
Southern Chile (Punta Arenas, Arcud)	427	370	82	74	35-38	34-35
	439	385	85	77		
	422	372	84	71		
	435		87			
Patagonia (Rio Gal- legos, Urbuhia)	428	378	75	76	35-39	34-36
	438	370	82	73		
	431	387	85	73		
	430	392	83	76		

438	396	86	75
425	394	80	76
405		85	
432		86	
435		88	
		82	
		81	

Such differences in size were pointed out by Oustalet (Mission scientifique au Cap Horn, 1891, Paris, vol. 6, pt. 1, zoologie, p. 191), but apparently no later authors took any notice of his excellent remarks.

All Falkland males are pure white underneath, entirely similar in color to some of the continental and Fuegian birds, but our series show clearly a distinct difference in the color of the females: the Falkland specimens have the black barring of the under parts narrower, the ruddy brown bars being almost twice as broad as the black ones, so that they look lighter and redder than the continental birds in which the black bars are wider than the brown ones. Also the under tail-coverts and the vent are whitish in the Falkland birds, blackish gray in the continental ones. It appears from the scanty material at hand that the chicks differ; those from the Falklands are duller, the pale gray bands over the eyes, on the sides of the back, and on the wings being much smaller, darker, and almost obsolete, while they produce a distinct and showy pattern in South American chicks.

There is a name available for the large Falkland subspecies: *Chloephaga picta leucoptera* (*Anas leucoptera* Gmelin, 1789, *Systema naturae*, vol. 1, pt. 2, 1789, p. 505; Falkland Islands).

The lesser continental and Fuegian Magellan Shelgeese present, however, another problem. While the females are alike throughout the range, if consideration of season, age, and individual variation is duly taken, the males are distinctly dimorphic, plain white or barred across the breast and the belly. The two phases may be found together in almost any locality. The great majority of the birds in Tierra del Fuego are barred, and white-breasted males are rather exceptional, as either isolated specimens or in small groups among the others. Both phases are found in variable proportions along the Strait of Magellan. Farther north in Chile and Patagonia, the males are mostly white breasted; barred and intermediate birds are often scarce, or even absent altogether in certain districts. It appears that there is a tendency to a segre-

gation of the barred form in the south, and of the white-breasted one in the north. But both may occur in many areas.

The degree of barring is variable, some specimens being considerably more heavily marked with black than others. Some are intermediate between the two phases, having white patches on the under parts, or being white with irregular black bars. Barred males have the tail entirely black; white-breasted males have two to four outer pairs of rectrices white. The shade of the gray on the wings also varies and is much darker in barred birds, which also usually retain a buffy wash on the head and neck. The barring of the flanks and mantle varies widely according to individuals in both phases. The question has been further complicated because immature males of the white-breasted phase, and of the Falkland form, show irregular black spotting and lining on the under parts, the full adult plumage being assumed in the third year only.

Because of such instability in characteristics and in distribution, it is difficult to accept subspecific distinctions in those populations. At least until more is learned of these shelgeese, it seems preferable to consider that the name *dispar* (Philippi and Landbeck, 1862, An. Univ. Chile, vol. 21, p. 431), applying to the barred phase, is a synonym of *C. p. picta* Gmelin (1789, Systema naturae, vol. 1, pt. 2, p. 504), a name that has been given to a white-breasted bird after the "Painted Duck" of Latham (1789, A general synopsis of birds, vol. 3, pt. 2, p. 443) from Staten Island.

We therefore recognize two subspecies of Magellan Goose:

1. *Chloephaga picta picta* (Gmelin); southern Chile, Patagonia, Tierra del Fuego, and neighboring islands
2. *Chloephaga picta leucoptera* (Gmelin); Falkland Islands

Examination of large series of *C. rubidiceps* and *C. poliocephala* has failed to reveal any stable variation throughout their range.

The Kelp Shelgoose, *C. hybrida*, however, varies in the same way as *C. picta*. The Falkland Islands population is larger: *C. h. malvinarum* Phillips (1916, Auk, vol. 33, p. 423). Our series does not confirm any constant difference in the color of the crown of the females as has been alleged in the description, but the barring of the breast and flanks is consistently much coarser in Falkland than in South American birds, the white lines being twice as broad. This striking characteristic so far does not appear to have been noticed.

